Study on wines produced from the Greek grape variety of Assyrtiko cultivated in Santorini Island, Northern Greece and Peloponnese

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Abstract

The purpose of the study was to identify the differences during the fermentations as well as those to the final products, the wines. The grapes were sent to the Agricultural University of Athens from Santorini Island, Drama in Northern Greece and Nemea at Peloponnese. They were collected at 11,8 and 12,6 Be and for each Baume grade two kinds of fermentations were conducted, prefermentative and classical fermentation. The vinifications took place in 15 litters containers automatically online connected to an innovative heating/cooling control system, called VinPilot from WFT Winetechnology .It is a fermentation control system for microvinification which allows to control and record via the pc all temperature settings, treatments and analyses. The 12 wines produced (3 areas x 2 Baume grades x 2 kinds of fermentations), showed significant differences even to classical analyses. Organoleptic test of the wines showed a wide range of aromas differentiating the aromatic profile for each area.

1. Introduction

V.Vinifera L. cv. Assyrtiko is considered to be the most interesting Greek white variety originating from the island of Santorini. It is well – adapted on the volcanic ground of the island of Santorini and its special climatic conditions (Chapa, Fallis & Farrel, 2001). Because of its interest, viticulturists tried to adjust the variety to other kinds of soil and climatic conditions all over Greece, for the last years with great success. The volcanic soil of the island, the lack of rain during the year, the sea's fog and the strong wind during the summer months as well as the low production vineyards aged 3000 old, appear to be some unique characteristics that develop in the grape variety, and therefore in the wine. One of these characteristics is that Assyrtiko does not lose its acidity even if it is very ripe. In Santorini island, Assyrtiko is used in the production of dry and sweet wines, including Vinsanto-like musky and syrup-sweet dessert wines(*Vitis* International Variety Catalogue accessed 2010-11-23). In the mainland , where the temperature is lower during the winter, the rainfall is higher along with the morning mist ,and the summer is less windy while the production / hectar is higher Assyrtiko gives less intense but more fruity wines and it has already gained Macedonia, Central Greece and Peloponese.
It is well known that wine, as produced by the action of yeast on grape juice musts, stands as a beverage of high commercial importance and consumer regard. Much of the appeal of wine can be attributed to the varied nature of the product. Wines can be distinguished by grape variety (Dunlevy et al, 2009, Ebeler &Thorngate, 2009), geographic location of vineyards,(Heymann & Noble, 1987) and variations in the same vineyard.(Bramley, Ouzman & Boss, 2011), Different viticultural practices as well as winemaking and aging techniques can vary greatly the sensory attributes of wines (Robinson et al, 2011, Swiegers et al, 2005, Singleton, 1995) .

Since wine is a complex mixture of organic as well as inorganic compounds its composition is influenced by many and varying factors. These begin in the vineyard and end in the fermentation cellar. They are related to the oenological environment including ground, climate and variety of starting vine, and oenological practice (Arvanitoyannis et al, 1999). The environmental factors (topographical, agro-pedological, climatic), usually described by the French term "terroir", have been acknowledged to influence grape and wine quality. (Koundouras et al., 2006)

The aroma profile is also very important in wine, as it contributes to the quality of the final product; it is due to the combined effects of several volatile compounds mainly alcohols, aldehydes, esters, acids, monoterpenes, and other minor components already present in the grapes or being formed during the fermentation and maturation process. All these compounds are responsible for their so-called bouquet on sniffing the headspace from a glass and the odor/aroma component (palate/aroma) of the overall flavor perceived on drinking. Several factors, such as environment (climate

and soil), ripeness and grape variety, winemaking as fermentation conditions, and ageing, influence the type and amount of volatile compounds.(Verzera et al., 2008)

In a study conducted by Fischer et al. 1999 the impact of geographic origin, vintage and wine estate on sensory properties of commercial Riesling wines were investigated. The study has shown that wines differ substantially regarding to their flavor within the same wine yard designation.
While referring to winemaking conditions, skin extraction is normally used by the winemaker to enhance the varietal character of white wines and generally to produce wines with higher aromatic intensity. This procedure provides acceptable, well-balanced, better rounded wines, with a stronger body in the mouth; however, it occasionally alters the wine typicity (a technical term used to describe the degree to which a wine reflects its varietal origins) and introduces heavy, coarse aromas (Ribereau-Gayon *et a*l, 2000). During recent years, many winemakers have been experimented be applying this method to Assyrtiko grapes in order to produce more intensively aromatic white wines (Symeou *et al*, 2007).
The target of this work was to study the impact of three geographic areas to the chemical and sensory characteristics of Assyrtiko.Then to investigate the influence of maturity as well of the vinification process on the same parameters.

2. Materials and Methods

2.1 Wine Samples

Grapes of Assyrtiko were collected by picking "random" bunches of berries from the whole vineyard, at two different ripeness stages (between 10^{th} and 15^{th} of August), at 11,8 and 12,6 Baume (sample code u=unripe for 11,8 and m=mature for 12,6) for each ampelographic area and were sent (under freezing conditions) to the Agricultural University of Athens. Two grape samples for each area, one for each Baume grade, 2x3= 6 samples in total. The wineries that provided us with the grapes are: GAIA winery at Santorini and at Nemea (Peloponnese) and Pavlidis winery at Drama (Northern Greece).

2.2 Fermentation conditions

The samples were processed (hand destemming and hand crushing) separately to obtain two batches of must, one by direct pressing of the grapes (sample code DP) and the other originating from the berries subjected to skin maceration (contact) at 10-12 ^{0}C for 12 h (sample code SC).For each Baume grade two kinds of fermentations were conducted, one by direct pressing of the grapes, and the other subjected to skin contact. For the 6 grape samples subjected to 2 different kinds of vinifications 12 musts were produced. All the samples were duplicated so totally 24 wines were produced.
Pottasium metabisulfite was added to the grapes prior to pressing adjusting the total SO_2 to 70mg/l as well as Ascorbic acid adjusted to 250mg/l.
Clarification was realized by gravity-induced sedimentation at 10^0C for 12h. The conditions were for the clean musts to have an NTU value of around 100.

All of the musts were inoculated with 0.25g/l of commercial *Saccharomyces cerevisiae* yeast strain (58W3) and yeast's nutrient Fermaid 25g/hl.
Fermentations were conducted in 15 litters (kept at 17^0C throughout) containers automatically online connected to an innovative heating/cooling control system, called VinPilot from WFT Winetechnology. It is a fermentation control system for microvinification which allows controlling and recording via the pc all temperature settings, treatments and analyses.
Evolution of fermentations was followed by measuring Baume grade.

2.3 Chemical Analyses

Analysis of ethanol, reducing sugars, absorption at 420nm, volatile acidity, pH, total acidity, and total phenols (adsorbance at 280nm) were determined using OIV methods, (OIV,2013). The nephelometric turbidity units (NTU) were measured using a Hacsh 2100P portable turbidity meter (Beavercreek, OH).

2.4 Sensory Analysis

1) Triangle tests: Sensory analysis triangle tests were conducted at the department of Enology, TEI of Athens in order to assess the differences between the wines. A (10 member) trained panel tasted the wines, evaluating the aroma and taste.

To balance out any order effects that may occur, the order of presentation was randomised for each subject for the three replications. All members of the panel were asked to rate the intensity of all attributes on a scale from 0-10, with the grade of 10 representing the maximum. The attributes they had to evaluate were the following: aroma, taste and overall acceptance. (Larmond, 1969 and Jackson, 2002)

2) Descriptive : Repeatability of the judges was evaluated by giving the same wine sample 3 times and measuring the standard deviation of their results. Wine samples were analyzed by quantitative descriptive analysis.

Graphical representation of the sensory profiles including odor and flavor characteristics were provided as spider-web diagrams by plotting the mean values for the sensory descriptors.
The sensory profile of wines include the following categories :
Citrus fruits (grapefruit, lemon, lime, mandarin)
Tree fruits (pear, apple, green apple, peach)
Tropical fruits (melon, guava, pineapple, passion fruit, lychee
Floral (honeysuckle, hawthorn, orange blossom, linden, jasmine, acacia, violet, lavender, rose)

3 Results and Discussion

As seen in Table 2 all Nemea wines had the highest Total acidity and A_{420} and the lower pH showing the dependance of the above to the terroir and no the fermentation's treatments or the sugar content (Be). Skin contact increased the total phenolics of wines no matter the grape's origin but did not affect the wine's Browning.

Nemea wines also had the highest values in all classical analyses (alcohol, total acidity, volatile acidity, pH, total phenolics and A_{420}.
Increased volatile acidity in Nemea wines was probably the result of long lasting fermentation which had as a consequence the exposure to O_2.
According to (Kechagia et al, 2008) Assyrtiko wines in 2004 vintage , produced by skin contact, presented higher total phenolics and browning indices (absorbance at 420nm), which signifies that the dissolution of phenolic compounds was realized during the maceration, in accordance with our results and previous works also (Selli et al, 2006, Cabaroglou et Canbas 2002))
Total Acidity values were not lower in case of skin macerated samples as expected, and pH values were lower, except from Drama's wines which had higher values of pH. Using skin contact usually leads to lower total acidity and higher pH because of liberation of potassium from the skins and thus partial salification of tartaric acid (Cabaroglou et Canbas 2002). Reducing sugars were found to be inferior to 2 g/L in all samples.
Globally, according to the results found in this experiment, skin contact did significantly result in wines with higher total phenolics and browning indexes.

Table 1. Analyses of grape musts

MUSTS	BAUME	pH	Total acidity ($g\ l^{-1}$ tartaric acid)
NEMEADPu	9.7	2.56	9.2
NEMEASCu	9.8	2.58	9.0
NEMEADPm	14.4	3.11	8.4
NEMEASCm	14.7	2.74	7.6
DRAMA Dpu	11.6	3.07	5.5
DRAMA SCu	11.8	3.22	5.7
DRAMADPm	12.7	3.06	5.2
DRAMASCm	12.9	3.07	5.1
SANTO.DPu	11.3	3.04	6.8
SANTO.SCu	11.1	3	6.5
SANTO.DPm	12.3	3.18	6.1
SANTO.SCm	12.3	3.06	6.3

Table 2. Classical Analyses results for all wines,

WINES	alcohol% v/v	Total acidity (g l^{-1} tartaric acid)	PH	Absorbance at 420nm	Total Phenolics	Volatile acidity (g l-1 acidic acid)
NEMEADPu	9,4	9,9	2,63	0,16	14,5	0,14
NEMEADPm	16,2	8,4	3,06	0,44	13,2	0,24
NEMEASCm	16,2	7,9	2,88	0,41	16	0,29
NEMEASCu	10	9,3	2,62	0,43	15,8	0,12
DRAMA Dpu	13,5	5,5	3,22	0,24	11,4	0,13
DRAMADPm	13,8	5,2	3,1	0,17	12,1	0,09
DRAMASCm	14,4	5	3,32	0,49	13	0,1
DRAMA Scu	13,1	5,6	3,35	0,36	13,6	0,09
SANTO.DPu	11,9	6,7	3,04	0,27	14,3	0,06
SANTO.DPm	13,6	6,3	3,28	0,33	15,7	0,06
SANTO.SCm	13,8	6,1	3,16	0,35	17,8	0,09
SANTO.SCu	11,3	6,5	3	0,37	16	0,08

NEMEA= WINES FROM NEMEA

DRAMA=WINES FROM DRAMA

SANTO=WINES FROM SANTORINI

DP=Direct pressing

SC=Scin contact

m=mature

u=unripe

Figure 3 . Odour profile diagram for all 24 wines

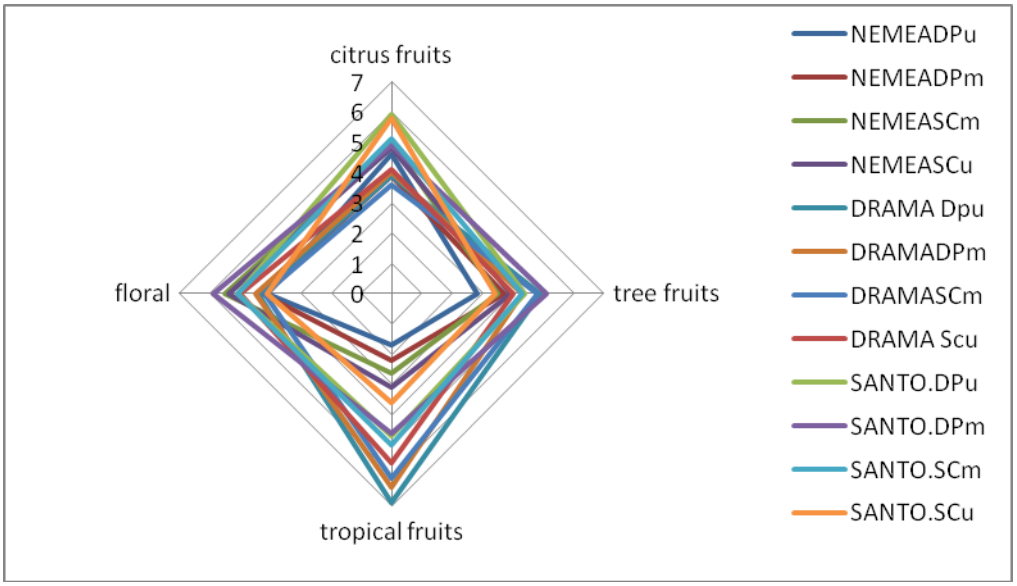


Figure 4 . Flavor profile diagram for all 24 wines

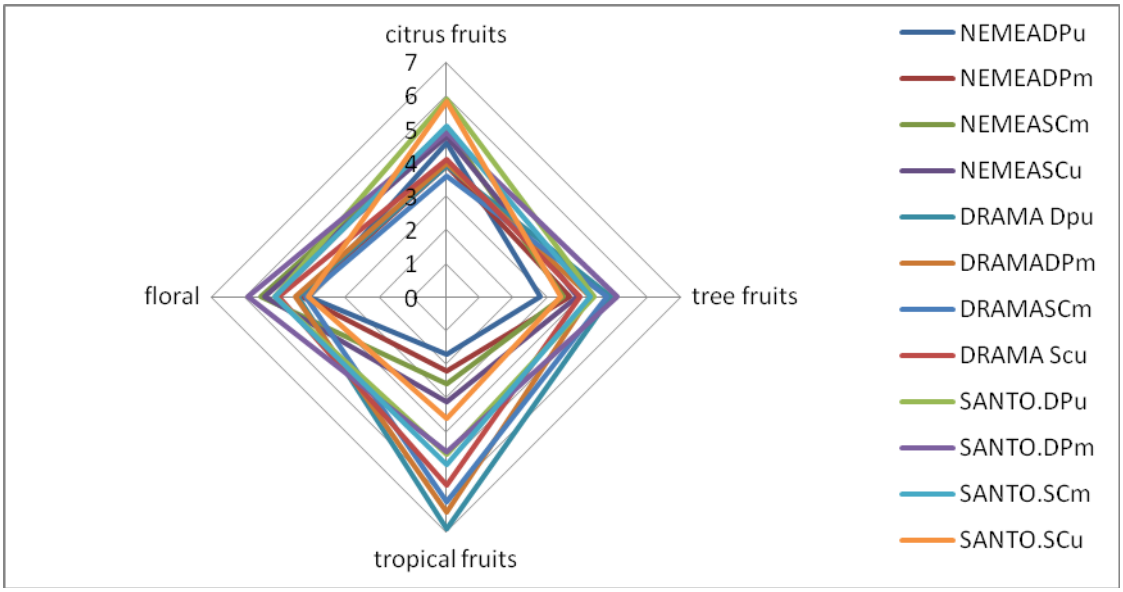
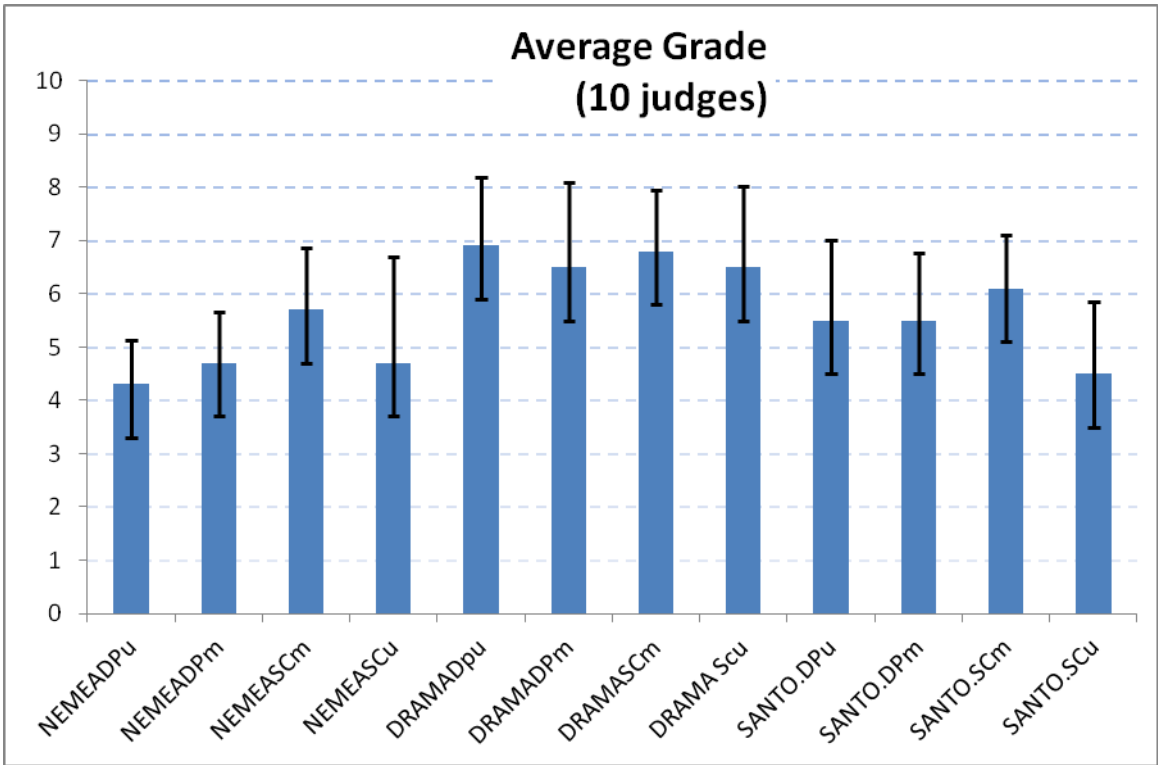


Figure 5 . Average grade of panel for all 24 wines and STD



The aromatic profile of wines (Figures 3 & 4) showed that Drama' wines had an intense aroma and taste of tropical fruits while those from Nemea was more citrus and from Santorini was citrus and floral. The STDV of the average score (Figure 5) the 10 judges gave for every wine showed that Nemea skin contact unripe wine (NEMEA SCu) divided the panel, while the wines from Drama were given higher grades.

The above results cannot verify the fact that Assyrtiko from Santorini island should as has already been noted in relation to the effects of vineyard soil and weather, that moderate water deficit can improve wine quality, enhancing colour, flavour and/or aroma (Deluc et al., 2009; Ou et al., 2010)

The skin contact technique is able to improve the quality of a white wine due to an increase of the flavour extraction from the skins (Darias-Martı´n et al., 2000; Falque´ & Ferna´ndez, 1996; Ough, 1969). In this sense, the grapes must be sufficiently ripe because skins of unripened grapes can increase the herbaceous character of the wines markedly because of the excessive amounts of C-6 compounds (Baumes, Bayonove, Barillere, Samson, & Cordonnier, 1989; Ferreira et al., 1995).

On the other hand, the skin contact process also causes a greater extraction of phenolic components (Ho et al., 1999) as it is verified by the results from Table 2 for all wines produced by Skin Contact, SC (values of Total Phenolics).
With reference to the phenolic compounds, it is well known that they are responsible for some of the major organoleptic properties of wines, particularly colour and astringency. These compounds contribute to the colour stability because they can act as oxidation substrates in white wines (Karagiannis, Economou, & Lanaridis, 2000; Soleas, Diamandis, & Goldberg, 1997; Teissedre, Frankel, Waterhouse, Peleg, & German, 1996). Values of Absorbance at 420nm from Table 2 are in accordance to the above. Therefore, the colour changes in white wines due to browning, such as the loss of the bright pale-yellow colour, which might occur when the total phenolic content is too high (Benı´tez, Castro, Sa´nchez, & Barroso, 2002; Boulton, Singleton, Bisson, & Kunkee, 1996).
No correlation can be found from values of classical analyses of wines and the sugar content of grapes at harvest (Baume grade), Table 2.

4 . Conclusions

Utilizing classical chemical analyses and sensory analysis of wines produced from Assyrtiko grapes, cultivated in three different geographical areas in Greece, Santorini island, Drama in Northern Greece and Nemea in Peloponnese showed that ampelographic area and sugar content at harvest (Baume grade) do not have significant impact on wine's quality such as vinification conditions does (classical fermentation or prefermentative vinification).
The correlation of the terroir to the aromatic profile of the examined wines imposes the need for further analysis of the quality and quantity of the wine's aroma by Gas Chromatography - MS. This study is already in progress, using the produced wines subjected to liquid extraction of volatile components from wines and then injected to GC-MS. Samples are being treated in triplicate and elaboration of the results is still running.

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