ajfand SCHOLARLY, PEER REVIEWED
AFRICAN JOURNAL OF FOOD, AGRICULTURE, NUTRITION AND DEVELOPMENT
Volume 19 No. 3
June 2019
PUBLISHED BY AFRICAN SCHOLARLY SCIENCE COMMUNICATIONS TRUST
ISSN 1684 5374

Afr. J. Food Agric. Nutr. Dev. 2019; 19(3): 14726-14738 DOI: 10.18697/ajfand.85.17840

THE EFFECT OF AGEING TEMPERATURE ON THE SENSORY QUALITIES OF *HIBISCUS SABDARIFFA* (ROSELLE) WINE

Idolo I[1,2*] and LJ Marshall [1]

Ifie Idolo

*Corresponding author email: idifie@yahoo.com

[1]School of Food Science and Nutrition, University of Leeds, Leeds LS2 9JT

[2]Department of Food Science and Technology, Delta State University, Abraka, PMB 1 Delta State, Nigeria

ajfand SCHOLARLY, PEER REVIEWED AFRICAN JOURNAL OF FOOD, AGRICULTURE, NUTRITION AND DEVELOPMENT Volume 19 No. 3 June 2019 PUBLISHED BY AFRICAN SCHOLARLY SCIENCE COMMUNICATIONS TRUST ISSN 1684 5374

ABSTRACT

Wine, unlike most other food items can be stored for a very long time as ageing is positively correlated with wines of peak quality. However, as important as ageing is to wine quality, the temperature at which the wine is stored is even more critical as this factor alone can make or compromise the ageing process, thereby impacting the final organoleptic quality of the product. The aim of this study was to evaluate the impact of ageing temperature (6, 15 and 30 °C) for a period of 12 months on the sensorial attributes of roselle wine (*Hibiscus sabdariffa* wine). To achieve this, a sixty (60) sensory member panel (male and female) consisting of both experts and non-experts wine drinkers were recruited for the analysis. A balanced incomplete block (BIB) design was used for the study and the rating of the wine samples was based on a modified University of California Davis quality assessment rating of red wines. The data collected from the sensory evaluation was processed using the R.3.30 agricolae software package. The least square differences (LSD) was used to compare the mean ratings of the sensory attributes and significant differences between sample sensory attributes was established at p-value =0.05. The sensory data showed that in terms of colour rating on a scale of zero to three (where 0= poor; 3= excellent), wines aged at 6, 15 °C and 30 °C scored 2.31, 2.24 and 2.06, respectively. Although, there was no significant difference ($p < 0.05$) between samples at 6 and 15 °C in aroma and bouquet attributes, wines aged at 30 °C were significantly different ($p < 0.05$) from wines stored at 6 °C. With regards to the overall rating or final impressions of the wine samples, the data showed that wines aged at 6 and 15 °C had better scores those aged at 30 °C. The outcome of this study suggests that low temperature storage might enhance roselle wine organoleptic properties.

Key words: *Hibiscus sabdariffa,* roselle wine, ageing temperature, sensory analysis, quality attribute

ajfand SCHOLARLY, PEER REVIEWED AFRICAN JOURNAL OF FOOD, AGRICULTURE, NUTRITION AND DEVELOPMENT Volume 19 No. 3 June 2019 PUBLISHED BY AFRICAN SCHOLARLY SCIENCE COMMUNICATIONS TRUST ISSN 1684 5374

INTRODUCTION

Red wine when consumed shortly after fermentation is considered harsh in taste and texture. However, during ageing if the ideal temperature and storage conditions is maintained, the wines undergo significant modifications that improve the organoleptic qualities of the wine. [1, 2]. Wine quality is a multi-faceted construct, lacking a uniform and generally accepted definition [3]. Therefore, the term complex is regularly applied as a descriptor of the perceived characteristics of a wine and those involved in the study of wine quality talk about perceived quality and how various populations differ in their perception [4]. According to Sáenz-Navajas [5], the quality dimensions of wine could be split into two types. The first comprises of external qualities, relating to issues beyond the physical and organoleptic properties of the wine. These include factors like the reputation, region, advertising, brand, price, bottling and labelling. The other category, which is much larger, relates only to what is experienced when the wine is consumed – the organoleptic nature of the product. These include balance, complexity, length (the persistence of the taste after the wine has been swallowed), personality or distinctiveness, intensity of flavour and purity [6].

For wine quality evaluation, a scheme developed at the University of California at Davis is commonly used. In this method, points are assigned in sensory categories such as appearance, colour, aroma and bouquet, volatile acidity, total acidity, sweetness, body, flavour, bitterness, and general quality. While the scoring card might not be fully applicable to wines of equal or high quality, it can be used to screen out wines that have obvious defects [7].

Roselle (*Hibiscus sabdariffa*) is a tropical crop grown in Nigeria and most sub-Saharan Africa countries [8]. Its brilliant red calyces is the part of the plant sought out by consumers for the manufacture of teas, drinks, jam, and marmalade. In order to diversify the functional properties of *H. sabdariffa*, its use in the manufacture of wine has been explored [9].

Although there have been a few published sensory studies on roselle wine, these studies have mainly focused on the acceptability of the wine [10-12], which is not synonymous with product quality. Furthermore, to the best of our knowledge, there are no published studies on the impact of ageing temperature on roselle wine sensory attributes. Since the UC-Davis score card is a tool designed to identify product defects, the information generated from this kind of study could be used to identify aspects of the wine's intrinsic qualities that might be flawed as a result of inappropriate storage or ageing temperature. [1, 13] The aim of this study was to determine the effect of ageing temperature on the sensory qualities of roselle wine.

MATERIALS AND METHODS

Roselle wine was produced and aged according to previous published methods [9, 14]. Briefly, the wine was produced by fermenting dark red *Hibiscus sabdariffa* calycles at 30 °C. Wines were racked and transferred into standard green wine bottles (750 mL) to

allow for the commencement of the ageing process. Three temperature conditions (6, 15 and 30 °C) were employed for ageing and the duration of storage was 12 months.

Chemical parameters of wine

Volatile composition and anthocyanin content (Table 1) that could influence the sensory rating of the wines were analysed using GC-MS and HPLC methods [9, 14].

Design of the sensory study

A total of 60 people comprising of male and female mainly from the University of Leeds, UK were recruited for the sensory analysis. The panel had both regular wine consumers/experts as well frequent consumers who were all trained on how to rate the different wine samples. The tasting room consisted of individual booths with the front of each booth opening onto the preparation room as shown in Figure.1. The wine bottles were transferred to the sensory stations 2 hrs to the commencement of sensory analysis to allow for equilibration with the room temperature.

A previously published wine tasting procedure [15] was employed for the sensory analysis. Wine samples (40 mL) were carefully measured into wine tasting glasses (ISO) (Figure 2) and covered with disposable plastic petri dish for about 30 min before serving. This was to give time for the wine to "breathe". The participants were then briefed on the analysis required of them but were not given any knowledge about the samples to be rated. The instructions (Table 2) on how the tasting session would run were made available through the Compusense program installed on the computer and were again re-iterated verbally to the panellist prior to the commencement of the analysis.

The wine samples were given to the panellists after signing the consent forms. They were encouraged to take unsalted crackers and water in-between samples to rinse the palate. The rating of the quality attributes of each wine sample was based on a modified Davis model quality assessment scoring sheet (Table 3) and the tasting took place over two consecutive days. On each of the days, there were two sessions (11.00 am to 1.00 pm and 2.00 pm to 4.00 pm) with equal number (30 panellists) attending.

Statistical analysis

The data collected from the sensory evaluation was processed using the R.3.30 agricolae software package. Significant differences were assessed with the BIB least significant difference (LSD) test ($p < 0.05$).

RESULTS AND DISCUSSION

The data on roselle wine quality attributes rating by the sensory panel is presented in Table 4. The anthocyanin content, delphinidin 3-*O* sambubioside and cyanidin 3-*O* sambubioside (Table 1) showed significant differences between ageing temperatures and this might have influenced the sensory characteristics, as there was a significant difference ($p > 0.05$) in the rating of the appearance and colour between wines aged at 6 and 15 °C. In terms of the aroma attributes of roselle wine, the chemical analysis by GC-MS revealed that diethyl succinate (vinous) was the aroma compound that was most influenced by ageing conditions (Table 1) and when in excess above threshold

concentration, it might impact negatively on the wine. Wines aged at 30 °C had the highest diethyl succinate concentration and were significantly different from wines kept at 6 °C. The taste of wine has to do with the sensations of sweetness, sourness, bitterness and astringency. Sweetness is usually the most rapidly detected taste sensation perceived at the tip of the tongue. Sourness is also detected rapidly and at the side of the tongue, while the perception of bitterness is detected later at the back and central portions of the tongue. The acids (organic and volatile) and the phenolic compounds present in wines are the main components that influence the flavour and taste of wines. In this study, there was no significant difference ($p > 0.05$) between roselle wines, which suggests that ageing temperatures did not influence the rating of the flavour attribute of the wines.

The balance of wine which has to do with the ratio of acidity to sweetness is closely related with the flavour and taste of wine. The results suggest that ageing temperature did not produce any significant difference ($p > 0.05$) in the balance attributes of the wine samples. The finish or persistence of wines has to do with the lingering aromatic sensations in the mouth. The duration of the lingering sensation is dependent on the wine characteristics and may last for a few seconds to several minutes. The finish tends to be fleeting and only compounds that persist and escape from the saliva/mucus are likely to be detected by the consumers. The results showed no significant difference ($p > 0.05$) in the finish of the wine samples. In a study on the persistence of aroma compounds in Chardonnay wines, the fruity volatile compounds (ethyl esters) were more easily dissipated than volatiles derived from oak ageing (vanillin, β-damascenone) and the higher alcohols (isoamyl alcohol and 2-phenylethanol) [16]. In this study, it is difficult to predict whether the final levels of higher alcohols in the wine samples could have influenced the ratings of the finish in the wine samples, since ageing temperatures did not produce any significant difference ($p > 0.05$) in the concentrations of these volatile compounds (Table 1).

According to Amerine and Roessler [6], the overall quality of wines is easier to detect than define. The different aspects of regional and varietal characteristics; along with the development (duration and complexity of the fragrance), and the uniqueness of the tasting experience and the taster perceptive acuity, all sum up the overall quality of the wine. The data on the overall quality rating of roselle wine revealed that there was no significant difference ($p > 0.05$) between ageing temperatures.

To compare the findings on the quality attributes of roselle wine with other published studies on grape wine would be a daunting exercise as the concept of wine quality still remains a variable subject. Furthermore, it is known that individuals vary for many reasons in their evaluations of food and beverages [17]. For instance, in a study where the quality attributes of 27 California wines were rated by experts, consumers and a trained group, the results showed a broad range of liking and variability and inconsistency, as some wines rated as low in quality by experts were preferred by some consumers [18]. Nevertheless, it is possible to make comparison between studies that have examined the impact of ageing temperature on the rating of the quality and sensorial attributes of wine. For example, the effect of two ageing temperatures (12 and 22 °C for 320 days) on the aroma profile of red Sangiovese wines was evaluated by a sensory panel and in most of the aroma and taste attributes, there were no significant differences ($p >$

0.05) [19]. However, in another study, using a rating scale of 1-10, the impact of ageing temperature (5 °C and commercial conditions) on the overall quality of wines aged for 12 and 24 months was investigated by a sensory panel [20]. The results showed that the mean scores for wines aged at 5 °C were 5.9 and 5.25 for 12 and 24 months, respectively, while for wines aged under commercial conditions, the mean scores were 5.87 and 3.75, respectively. The data also showed a statistical difference ($p < 0.05$) between wine samples at 24 months but not at 12 months. The data obtained by Pérez-Coello *et al.* [20] is similar to what was observed in this study (12 months ageing), as the wines that were aged at 6 and 15 °C were considered better for overall quality than wines aged at 30 °C. Furthermore, it is likely that the duration of ageing in this study (365 days) and that of Castellari *et al.* [19] (320 days) were not sufficient for panellist to completely differentiate between the wine samples.

CONCLUSION

The quality attributes of roselle wines aged under three different temperatures were evaluated by a 60-member sensory panel. The data on roselle wine quality ratings showed that wines aged at 6 and 15 °C were generally rated better in colour, aroma and bouquet and overall acceptability compared to wine stored at 30 °C. However, in other quality parameters investigated, ageing temperature did not produce any obvious trend between samples. This first study of this kind on roselle wine and future research could be directed at carrying out a descriptive sensory analysis on roselle wine using a trained panel to provide more insight on its aroma attributes (such as floral, vegetative, earthy) and how they are influenced by ageing temperatures. The data generated from these kinds of studies will provide roselle wine producers with information on post-fermentation handling of the wines and provide them a new analytical tool to achieve the desired outcome in the final product quality.

ACKNOWLEDGEMENT

Idolo Ifie is grateful to the Educational Trust Fund Nigeria and Delta State University, Abraka, Nigeria for PhD funding. The authors of this manuscript declares that there is no conflict of interest.

ajfand SCHOLARLY, PEER REVIEWED
AFRICAN JOURNAL OF FOOD, AGRICULTURE, NUTRITION AND DEVELOPMENT
Volume 19 No. 3
June 2019
PUBLISHED BY AFRICAN SCHOLARLY SCIENCE COMMUNICATIONS TRUST
ISSN 1684 5374

A

B

Figure 1: (A) sample preparation room and (B) tasting booths

Figure 2: ISO official wine tasting glass

DOI: 10.18697/ajfand.86.17840

ajfand SCHOLARLY, PEER REVIEWED AFRICAN JOURNAL OF FOOD, AGRICULTURE, NUTRITION AND DEVELOPMENT Volume 19 No. 3 June 2019 PUBLISHED BY AFRICAN SCHOLARLY SCIENCE COMMUNICATIONS TRUST ISSN 1684 5374

Table 1: Chemical parameters of the wine after ageing at three different temperatures

Compound (ug/L)	Ageing temperatures		
	6 °C	15 °C	30 °C
2-phenylethanol	521 ± 52 [a]	564 ± 140 [a]	483 ± 45 [a]
isoamyl alcohol	269347 ± 23174 [a]	295046 ± 64401 [a]	252548 ± 7622 [a]
1-hexanol	149 ± 34 [b]	153 ± 79 [b]	103 ± 33 [b]
ethyl acetate	184 ± 45 [a]	226 ± 126 [a]	227 ±11 [a]
ethyl hexanoate	1703 ± 199[b]	1718 ± 459 [b]	1634 ± 339 [b]
ethyl octanoate	731 ± 105 [b]	803 ± 163 [b]	707 ± 31 [b]
ethyl decanoate	610 ± 81 [b]	607 ± 121 [b]	554 ± 36 [b]
diethyl succinate[a]	0.24 ± 0.03 [c]	0.40 ± 0.09 [b]	0.77 ± 0.13 [a]
Delphinidin 3-*O* sambubioside (mg/L)	123.05 ± 4.12[a]	35.77 ± 2.77[b]	6.21 ± 0.30[c]
Cyanidin 3-*O* sambubioside (mg/L)	38.72 ± 3.90[a]	10.52 ± 1.44[b]	3.02 ± 0.02[c]

The values are the mean ± SD. [a] Compound measured by semi-quantification; relative peak areas (compound: internal standard) were used to calculate means and standard deviation Values with different letters on the same row are significantly different $p < 0.05$ ($n = 6$)

ajfand SCHOLARLY, PEER REVIEWED AFRICAN JOURNAL OF FOOD, AGRICULTURE, NUTRITION AND DEVELOPMENT Volume 19 No. 3 June 2019 PUBLISHED BY AFRICAN SCHOLARLY SCIENCE COMMUNICATIONS TRUST ISSN 1684 5374

Table 2: Instructions for rating of roselle wine quality attributes

Attributes	Instructions For Rating Quality Attributes
Appearance and colour	Pick up the glass as shown in the picture. Raise it up to about 15 cm and tilt the glass forward by 45 degrees. Take a look at the content of the glass and rate the appearance and colour
Aroma and bouquet	Swirl the glass slightly and raise it up, placing your nose close to the glass and take a sniff for about 1 - 2 s, then rate the aroma and bouquet
Taste and flavour	Take a sip, keep the wine in your mouth for 1 - 2 s, before swallowing and rate the taste and flavour
Balance	Take a sip, keep the wine in your mouth for 3 - 5 s and rate the balance (sweetness at the tip and bitterness at the back)
Aroma development/duration	Bring the wine to your nose and sniff the wine for a short duration (1 – 2 s) and then a longer duration (4 - 5 s) then rate the aroma development and duration
Finish (taste and flavour)	Take a sip of wine; keep the wine in your mouth for 4 - 5 s before swallowing
Overall quality	Rate the overall quality based on your impression of the previous attributes

ajfand SCHOLARLY, PEER REVIEWED AFRICAN JOURNAL OF FOOD, AGRICULTURE, NUTRITION AND DEVELOPMENT Volume 19 No. 3 June 2019 PUBLISHED BY AFRICAN SCHOLARLY SCIENCE COMMUNICATIONS TRUST ISSN 1684 5374

Table 3: General score sheet modified from the Davis model [15]

ATTRIBUTES	SCORES	CATEGORIES	DESCRIPTION
Appearance and colour	1	Poor/unsatisfactory	Dull or slight off-colour
	2	Good	Bright with Characteristic colour as expected
	3	Superior or Excellent	Brilliant with characteristic colour
Aroma and bouquet	1	Faulty	Clear expression of an off-odour
	2	Poor/Off character	Marginal expression of an off-odour
	3	Acceptable	Absence of characteristic varietal-regional stylistic fragrance or bouquet but with no unpleasant off-odours
	4	Good	Mild to standard varietal-regional stylistic fragrance or bouquet
	5	Superior	Varietal-regional stylistic fragrance or bouquet which is distinctive and complex
	6	Exceptional	Rich, complex traditional fragrance or refined lingering aged bouquet
Taste and flavour	1	Faulty	Off tastes or off-odours so marked as to make the wine distinctly unpleasant
	2	Poor/unsatisfactory	Absence of varietal, regional or stylistic taste and flavour characteristics
	3	Good	Presence of distinctive varietal, regional, or stylistic taste and flavour characteristics
	4	Exceptional	Superior varietal, regional or stylistic taste and flavour characteristics
Balance	1	Poor/unsatisfactory	Acid/sweetness ratio inharmonious, excessively bitter and astringent
	2	Good	Acid/sweetness ratio adequate, moderate bitter and astringent
	3	Exceptional	Acid/sweetness ratio invigorating, smooth mouth feel
Aroma development/duration	1	Poor/unsatisfactory	Fragrance simple, does not develop, of short duration
	2	Standard/Satisfactory	Fragrance typical, develops in complexity, does not fade during tasting
	3	Superior	Fragrance improves with intensity and/or character, last throughout the tasting
	4	Exceptional	Rich fragrance, improves in intensity and character, long lasting
Finish (taste and flavour)	1	Poor/unsatisfactory	Little lingering flavour in the mouth, excessive astringency and bitterness
	2	Good	Moderate lingering flavour in the mouth, fresh aftertaste
	3	Exceptional	Prolonged flavour in the mouth (>10 to 15s), subtle, refined after-sensations
Overall quality	1	Poor/Unacceptable	Distinctly off-character
	2	Good	Acceptable representation of traditional aspects of the type
	3	Superior	Clearly better than the majority of the wine types
	4	Exceptional	So nearly perfect in all sensory qualities as to be a memorable experience

ajfand SCHOLARLY, PEER REVIEWED AFRICAN JOURNAL OF FOOD, AGRICULTURE, NUTRITION AND DEVELOPMENT Volume 19 No. 3 June 2019 PUBLISHED BY AFRICAN SCHOLARLY SCIENCE COMMUNICATIONS TRUST ISSN 1684 5374

Table 4: Quality rating of Roselle wine by sensory panel aged at 6, 15 and 30 °C for 365 days using the UC Davis quality rating of red wine

	Rating of quality attributes		
Wine attribute/sample	6	15	30
Appearance and colour	2.31 [a]	2.24 [ab]	2.06 [b]
Aroma and bouquet	3.64 [a]	3.43 [ab]	2.95 [b]
Taste and flavour	2.38 [a]	2.59 [a]	2.38 [a]
Balance	1.84 [a]	1.71 [a]	1.78 [a]
Aroma development/duration	2.02 [ab]	2.1 [ab]	2.17 [a]
Finish (taste and flavour)	1.87 [a]	1.91 [a]	1.89 [a]
Overall quality	1.89 [a]	1.97 [a]	1.75 [a]

The numbers 6, 15 and 30 refer to the ageing temperature. The data represents the mean scores of the quality rating by the panellists. Statistical differences were not found between wine samples at $p < 0.05$

ajfand SCHOLARLY, PEER REVIEWED AFRICAN JOURNAL OF FOOD, AGRICULTURE, NUTRITION AND DEVELOPMENT Volume 19 No. 3 June 2019 PUBLISHED BY AFRICAN SCHOLARLY SCIENCE COMMUNICATIONS TRUST ISSN 1684 5374

REFERENCES

1. **Mattivi F, Arapitsas P, Perenzoni D and G Guella** 2015. Influence of storage conditions on the composition of red wines. In *ACS Symp Ser*. 2015, (1203): 29-49.

2. **Butzke CE, Vogt EE and L Chacon-Rodriguez** 2012. Effects of heat exposure on wine quality during transport and storage. *J Wine Res*. 2012, **23(1)** 15-25.

3. **Hopfer H, Nelson J, Ebeler SE and H Heymann** Correlating Wine Quality Indicators to Chemical and Sensory Measurements. *Molecules.* 2015; **20(5)**: 8453-8483.

4. **Charters S and S Pettigrew** The Dimensions of Wine Quality. *Food Qual Prefer.* 2007; **18(7):** 997-1007.

5. **Sáenz-Navajas MP, Campo E, Sutan A, Ballester J and D Valentin** Perception of Wine Quality According to Extrinsic Cues. The case of Burgundy wine consumers. *Food Qual Prefer.* 2013; **27(1):** 44-53.

6. **Amerine MA and BE Roessler** Wines. Their Sensory Evaluation: Freeman San Francisco. 1976.

7. **Winiarski W, Winiarski J, Silacci M and B Painter** The Davis 20-point Scale: how does it score today? *American Wine Society*.1997.

8 **Ismail A, Ikram EHK, and HSM Nazri** Roselle (*Hibiscus sabdariffa* L.) Seeds-nutritional composition, protein quality and health benefits. *Food.* 2008, **2(1)**:1-16.

9. **Ifie I, Marshall LJ, Ho P and G Williamson** *Hibiscus sabdariffa* (Roselle) Extracts and Wine: Phytochemical Profile, Physicochemical Properties and Carbohydrase Inhibition. *J Agric Food Chem*. 2016; **64 (24):** 4921-4931.

10 **Alobo AP and S Offonry** Characteristics of coloured wine produced from roselle (*Hibiscus sabdariffa*) calyx extract. *J. Inst. Brew*. 2009, **115(2)**: 91−94.

11. **Mounigan P and N Badrie** Physicochemical and Sensory Quality of Wines from Red Sorrel/Roselle (*Hibiscus sabdariffa* L.) Calyces: Effects of Pretreatments of Pectolase and Temperature/Time. I*nt. J. Food Sci. Technol*. 2007; (**42):** 469-475.

12. **Okoro CE** Production of Red Wine from Roselle (*Hibiscus sabdariffa*) and Pawpaw (*Carica papaya*) using Palm-wine Yeast (*Saccharomyces cerevisiae*). *NIFOJ*. 2007; **25(2):** 158-164.

13 **Agriopoulou S and E Stamatelopoulou** Influence of Storage conditions on the quality characteristics of wines *EC Nutrition*. 2017 **8(3)** 93-98.

14 **Ifie I, Abrankó L, Villa-Rodriguez JA, Papp N, Ho P, Williamson G and LJ Marshall** The Effect of Ageing Temperature on the Physicochemical Properties, Phytochemical Profile and α-glucosidase Inhibition of *Hibiscus sabdariffa* (roselle) wine." *Food Chem* 2017.

15. **Jackson RS** Wine tasting: A Professional Handbook: Academic Press. 2009

16. **Buettner A** Investigation of Potent Odorants and after Odor Development in Two Chardonnay Wines Using the Buccal Odor Screening System (BOSS). *J Agric Food Chem.* 2004; **52(8)**: 2339-2346.

17. **Brien C, May P and O Mayo** Analysis of Judge Performance in Wine-Quality Evaluations. *J Food Sci.* 1987; **52(5)**: 1273-1279.

18. **Hopfer H, Nelson J, Ebeler SE and H Heymann** Correlating Wine Quality Indicators to Chemical and Sensory Measurements. *Molecules,* 2015; **20(5)**: 8453-8483.

19. **Castellari M, Piermattei B, Arfelli G and A Amati** Influence of Aging Conditions on the Quality of Red Sangiovese Wine. *Journal of Agricultural and Food Chemistry,* 2001; **49(8)**: 3672-3676.

20. **Pérez-Coello MS, González-Viñas MA, García-Romero E, Díaz-Maroto MC and MD Cabezudo** Inflence of Storage Temperature on the Volatile Compounds of Young White Wines. *Food Control,* 2003; **14(5)**: 301-306.