AROMA PROFILE OF 'PEDRO XIMENEZ' SWEET MUSTS OBTAINED FROM DRIED GRAPES BY DIFFERENT METHODS[1]

María J. RUIZ, Luis ZEA, Lourdes MOYANO, Manuel MEDINA*

University of Cordoba. Dept. of Agricultural Chemistry. Campus de Rabanales (C-3)14014 Cordoba, E.
* E-mail: qe1zecal@uco.es

Key words: aroma, odorant terms, grape dried.

1. INTRODUCTION

In recent years, consumption of sweet wines in the Montilla-Moriles Designation of Origin (southern Spain) has grown. The production process starts with sun-drying of the grapes for 5-10 days depending on climatic conditions. Proper raisining requires high diurnal temperatures and as low as possible ambient moisture. The more the prevailing weather departs from these ideal conditions, the slower and less efficient becomes raisining, and higher is the risk of increase in the content of fungal toxins, that can pass to musts first and wines later.

Alternatively to sun-drying, grains, fruits and cut vegetables are subjected to surface evaporation by forced convection with hot air in drying chambers in order to facilitate water loss. The hot air driers avoid some problems of the sun-drying such as growth of fungi toxin producers, when the hygrometric degree is not quite low, or contamination by dust and insects. In this work the aroma of musts from traditional sun-dried and chamber-dried 'Pedro Ximenez' grapes is examined, with a view to find a possible advantageous alternative in raisining stage for winemaking of Pedro Ximenez sweet Sherry wines.

2. MATERIAL AND METHODS

2.1. Musts

Three batches of ripe grapes (25 kg each one), cv 'Pedro Ximenez', were used. The first was traditionally sun-dried while the other two batches were dried by chamber-drying (Frisol Climatronic, Spain) at 40 ºC and 50 ºC, respectively, and humidity of 30 %. After drying, each grape batch was crushed and pressed in a vertical press at 20 ºC.

[1] QUAD. ViTIC. ENOL. UNIV. TORINO, 31, 2009-2010

2.2. Experimental analyses

Each aroma compound was identified by means of its retention time, coeluted with a standard solution of commercial product, and confirmed by MS (Hewlett-Packard 5972). For the quantification of the compounds, samples of 100 mL of must were adjusted to pH 3.5, 150 μg of 2-octanol was added as an internal standard and then extracted with 100 mL of freon-11 for 24 hours. After concentration of the extracts to 0.2 mL, 3 µL were injected into the GC (Hewlett-Packard 5890 series II) in a HP-INNOWax column (60 m x 0.32 mm x 0.25 µm) equipped with a split/splitless injector and a FID detector. The oven temperature program was as follows: 5 min at 45 ºC, 1 ºC min^{-1} up to 185 ºC and 30 min at 185 ºC. Injector and detector temperatures were 275 ºC and 300 ºC respectively. The carrier gas was helium at 70 kPa and split 1:30. The quantification was made by triplicate, using chromatographic response factors, calculated in relation to the internal standard.

2.3. Odor descriptors and odor activity values (OAV).

Direct olfaction of the commercial products on water solutions of each compound, with a concentration slightly higher than its perception threshold (10 %), was carried out (ISO 5496:1992). The taste panel consisted of 20 trained judges of both sexes: the odor descriptors and the perception threshold for the compounds studied were obtained from the bibliography (tab. 1). The OAV for each compound was calculated by dividing its concentration in the must by the concentration corresponding to its odor threshold.

Tab. 1 – Odor descriptors, odorant terms and threshold (μg L^{-1}) of the aroma compounds identified in the musts.

Compound	odor descriptors	odorant terms[a]	threshold
Ethyl acetate	pineapple, varnish, anise	tropical fruit, pungent, spicy	3280[b]
1,1-Dietoxyethane	green fruit, licorice	tree fruit, spicy	42[b]
2,3-Butanedione	buttery	caramelized	128[c]
2-Butanol	vinous	other chemical	3300[b]
2,3-Pentanedione	buttery	caramelized	20[b]
Hexanal	green	fresh	9.1[b]
Isobutanol	alcohol, wine like, nail polish	other chemical, pungent	16000[b]
Isoamyl acetate	banana	tropical fruit	2500[b]
1-Butanol	medicinal	phenolic	74000[b]
Isoamyl alcohols	alcohol, nail polish	other chemical, pungent	3060[b]
Hexyl acetate	apple, pear, banana	tree fruit, tropical fruit	115[b]
Acetoin	buttery, cream	caramelized	800[d]
Ethyl lactate	strawberry, raspberry, buttery	berry, caramelized	250000[b]
1-Hexanol	grass, resinous, cream	fresh, resinous, caramelized	1620[b]
E-2-Hexenol	green	fresh	100[b]
Furfural	burn almond, incense, floral	burned, floral	770[b]
Benzaldehyde	bitter almond, nutty, smoky	nutty, burned	4600[b]
5-Methylfurfural	bitter almond, spicy	nutty, spicy	1110[b]
Isobutanoic acid	rancid butter	lactic	50[b]
γ-Butyrolactone	coconut, caramel	tropical fruit, caramelized	1000[b]
3-Methylbutanoic acid	parmesan cheese, rancid	lactic	20[b]
Butanoic acid	rancid, cheese	lactic	1400[b]
Geranial	citrus, sweet	citrus, caramelized	410[b]
γ-Heptalactone	coconut, herbaceous, caramel	tropical fruit, fresh, caramelized	400[b]
Phenethyl acetate	rose, honey	floral, caramelized	5000[b]
Benzyl alcohol	fruity, walnut	tree fruit, nutty	100000[b]
Phenethyl alcohol	rose, honey	floral, caramelized	60[b]
Hexanoic acid	cheese	lactic	1800[b]
γ-Decalactone	peach	tree fruit	10[b]
Farnesol	fruity, balsamic, floral, clove	tree fruit, fresh, floral, spicy	20[b]

a= Wine Aroma Wheel terms; b = (From van Gemert, 2003); c = (From Porto, Nicoli, 2002); d= (From Lasekan et al., 2007)

3. RESULTS AND DISCUSSION

The OAVs for the 9 odorant terms which group the 30 compounds analyzed in the different musts from 'Pedro Ximenez' grapes, traditionally sun-dried and chamber-dried at 40 ºC or 50 ºC were compared (tab. 2).

Tab. 2 – Odor activity values (OAVs) of the odorant terms of the musts.

Odorant terms	Not-drying	Sun-drying	Chamber-drying 40 °C	Chamber-drying 50 °C
Caramelized	13 ± 1 a	131 ± 14 b	271 ± 7 c	102 ± 11 d
Floral	9 ± 1 a	14.7 ± 0.4 a	163.7 ± 0.3 b	61 ± 12 c
Fresh	5.6 ± 0.4 a	20 ± 1 b	2.0 ± 0.1 c	1.05 ± 0.07 c
Lactic	0.68 ± 0.02 a	2.4 ± 0,1 bc	2.8 ± 0.2 b	2.3 ± 0.2 c
Chemical	Not detected	0.83 ± 0.05 b	2.85 ± 0.02 c	2.7 ± 0.3 c
Pungent	0,16 ± 0,03 a	2.1 ± 0.1 b	6.9 ± 0.1 c	8 ± 1 c
Spicy	3.7 ± 0,2 a	37 ± 2 b	19 ± 1 c	24 ± 7 c
Tree fruit	4.1 ± 0,2 a	38 ± 2 b	28 ± 1 c	30 ± 6 c
Tropical fruit	0.44 ± 0.01 a	5.5 ± 0.2 b	5.4 ± 0.2 b	6 ± 1 b

a,b,c,d = homogeneous groups

Excepted the fresh term for the musts chamber-dried, at the end of the three raisining processes, the OAVs for all terms were higher than at the beginning, particularly the caramelized. In addition, taking into account that water loss was around the 50-55 % of the initial weight of the grapes, the OAVs increased in greater extension than the expected as result of the water evaporation. Therefore, it is reasonable to bear in mind that during the raisining take place reactions of synthesis by chemical or biochemical pathways. In order to observe significant differences among the OAVs for the odorant terms of the musts studied, a multiple range test at 95 % of confidence level was carried out for each term. The results showed that only the caramelized and floral terms were different in the musts from the three raisining processes.

The fresh, chemical, pungent, spicy, tree fruit and tropical fruit only were not different for the musts from chamber-dried grapes. Only the lactic term was different for the two conditions used in the chamber. On the other hand, the OAVs for the 9 odorant terms were subjected to principal components analysis (fig. 1).

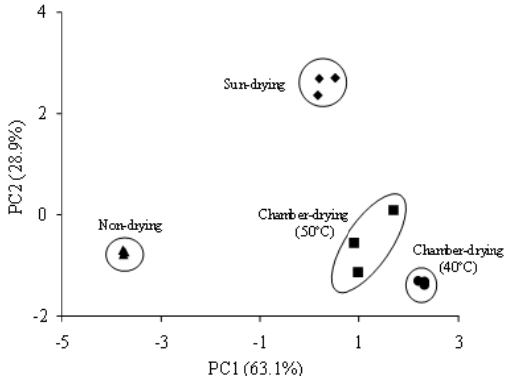

Fig. 1 - Principal components analysis performed on the odorant terms.

Jointly, the two first components account for 92 % of the overall variance, (63.1 % for PC1). The higher scores on this component of the musts from chamber-dried grapes could indicate that their aroma exhibited better characteristics than those from traditionally sun-

drying. Particularly, the raisining in chamber at 40 ºC could improve considerably the aroma of the musts destined to production of Pedro Ximenez sweet wines.

Abstract

Aroma fraction of musts from grapes 'Pedro Ximenez' traditionally sun-dried and chamber-dried at 40 ºC and at 50 ºC during 8, 5 and 4 days respectively, destined for the production of sweet wines in Montilla-Moriles region (southern Spain) was studied. The OAVs of the 30 analyzed compounds were grouped according to their similar descriptors into 9 odorant terms (caramelized, floral, fresh, lactic, chemical, pungent, spicy, tree fruit, and tropical fruit). The ANOVA at 95 % of significance performed on the above terms distinguished between musts from dried and non-dried (control) grapes. Only the caramelized and floral terms were different for the three drying methods. The remainder terms (excepted lactic) were not distinguishable between the musts from two chamber-dried grapes. The OAVs of the terms were subjected to principal component analysis. PC1 and PC2 were found to account for 92.0 % of the total variance (63.1 % and 28.9 %, respectively). The scores on PC1 could suggest that the musts from dried-chamber grapes at 40 ºC exhibited better aroma characteristics that the remaining ones. In this sense, the controlled drying process at 40 ºC could improve the winemaking process of Pedro Ximenez sweet wines.

Literature cited

Da Porto C., Nicoli M. - 2002 - A study of the physico-chemical behavior of diacetyl in hidroalcoholic solution with and without added catechin and wood extract. *LWT-Food Sci. Technol.*, 35, 466-471.

Gemert L. - 2003 - *Odour thresholds. Compilation of odour thresholds in air, water and others media*. Ed. Oliemans Punter & Partners BV, The NL.

Lasekan O., Buettner A., Christlbauer M. - 2007 - Investigation of important odorants of palm wine (*Elaeis guineensis*). *Food Chem.*, 105, 15-23.