IECM

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sponsored by metabolites

Can the increment of temperature associated to climate change alter the olive oil chemical composition and its nutritional and nutraceutical properties?

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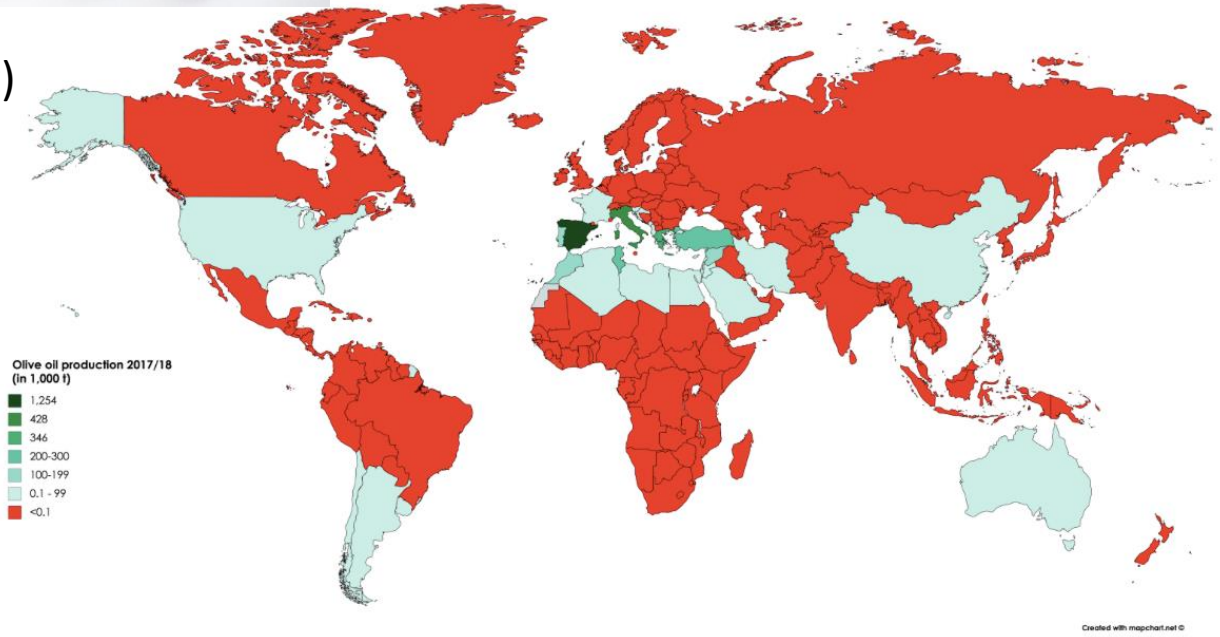
Introduction

- **Olive tree as experimental system**
  - Strategic crop for Spain.
  - 3 major varieties.

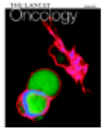
Olive oil production (1000 t)



Olive oil as nutraceutical food product

- Olive oil = olive juice without chemical extraction or aditives.
- High content FA (unsaturated) and low content FFA
- High content of polyphenols (antioxidant power) .
- Different vitamins, sterols, pigments…

THE LANCET
Oncology
Volume 1, Issue 2, October 2000, Pages 107-112



Review

Olive-oil consumption and health: the possible role of antioxidants

Dr Robert W Owen [a], Attilio Giacosa [c], William E Hull [b], Roswitha Haubner [a], Gerd Würtele [a], Bertold Spiegelhalder [a], Helmut Bartsch [a]

Monounsaturated fatty acids, olive oil and health status: a systematic review and meta-analysis of cohort studies

Lukas Schwingshackl and Georg Hoffmann

Lipids in Health and Disease 2014 **13**:154

Inflammopharmacology
April 2009, Volume 17, Issue 2, pp 76–84 | Cite as

Phenolic compounds in olive oil: antioxidant, health and organoleptic activities according to their chemical structure

Authors Authors and affiliations

M. Servili, S. Esposto, R. Fabiani, S. Urbani, A. Taticchi, F. Mariucci, R. Selvaggini, G. F. Montedoro

Thermal stress

- Climate change scenarios
- Thermal increase
- Mediterranean area with several damages.

Clim Change. 2012; 114(3-4): 667–687. PMCID: PMC4372776
Published online 2012 Mar 7. doi: 10.1007/s10584-012-0418-4

Climate change and impacts in the Eastern Mediterranean and the Middle East

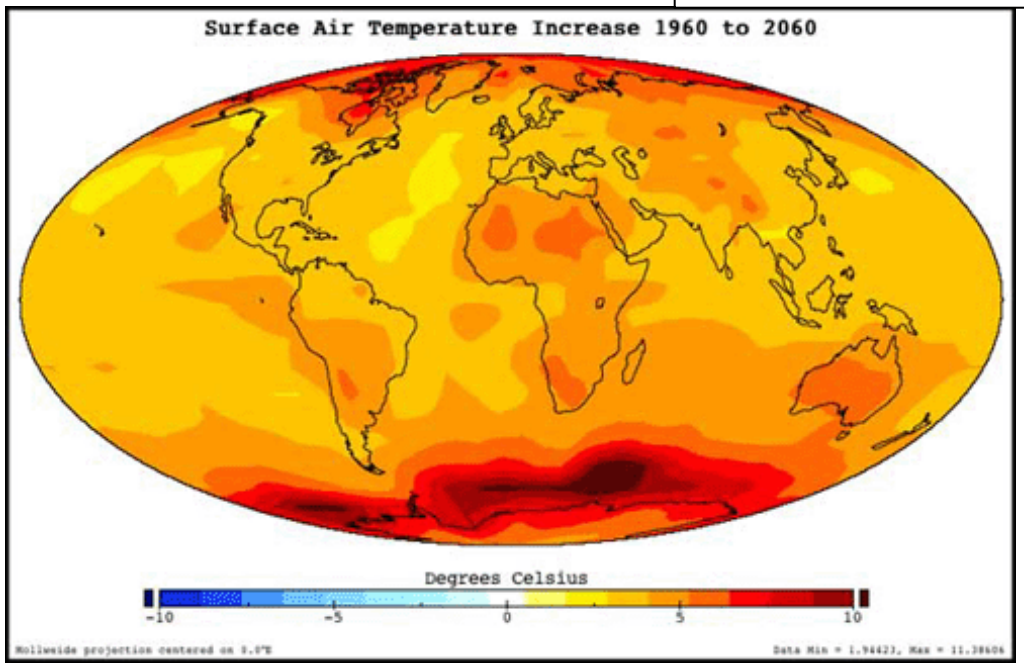
J. Lelieveld, P. Hadjinicolaou, E. Kostopoulou, J. Chenoweth, M. El Maayar, C. Giannakopoulos, C. Hannides, M. A. Lange, M. Tanarhte, E. Tyrlis, and E. Xoplaki

GEOPHYSICAL RESEARCH LETTERS, VOL. 34, L11706, doi:10.1029/2007GL030000, 2007

Heat stress intensification in the Mediterranean climate change hotspot

Noah S. Diffenbaugh,[1] Jeremy S. Pal,[2,3] Filippo Giorgi,[2] and Xuejie Gao[2,4]

Received 13 March 2007; accepted 14 May 2007; published 15 June 2007.



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Objectives

I. To study how thermal increase (+4ºC) affected to the development, maturity and organoleptic properties of olive fruits through phenology, morphometry and biomolecular approaches.

II. Metabolite profiles of ripening stages: i) green fruits; ii) turning red; iii) and purple pigmentation, were analyzed by UHPLC/qTOF strategy.

III. To identify the principal metabolites affected by thermal increase and that play a role in the quality of the oil (organoleptic and nutraceutical characteristics).

Materials and Methods

Experimental design

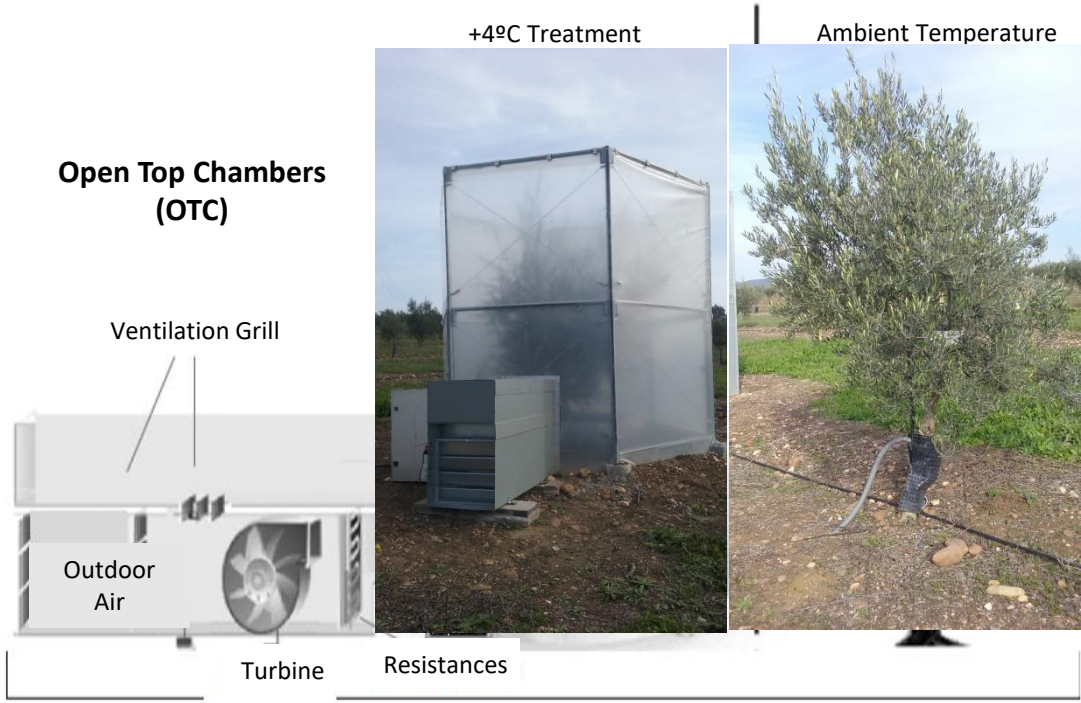
AT+4ºC:

- 8 OTC indoor trees

AT:

- 8 Control outdoor trees

Campaign 2015/2016



Phenology

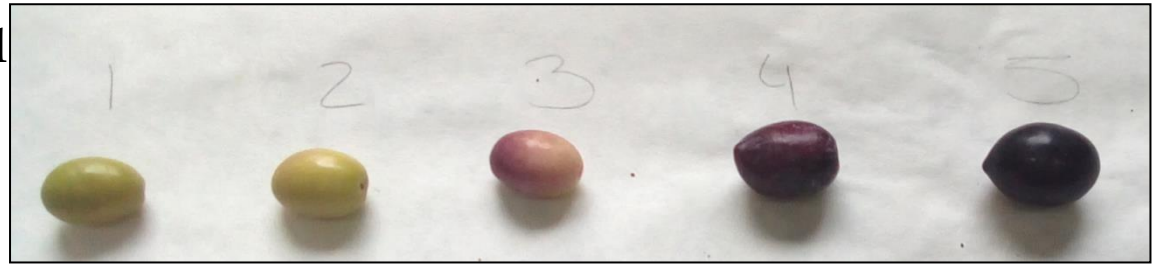
- Growth
- Flowering processes [1]
- Ripening processes

Morphology and chemical composition

- Total production
- Fruit size
- Fat yield
- Anthocyanins and polyphenols contents

Metabolomic approaches

- 5 ripening stages were collected
- 3 ripening stages were selected



[1] Benlloch-González et al. (2018). Scientia Horticulturae, 240:405-410.

Metabolomic analysis by UPLC-MS/MS

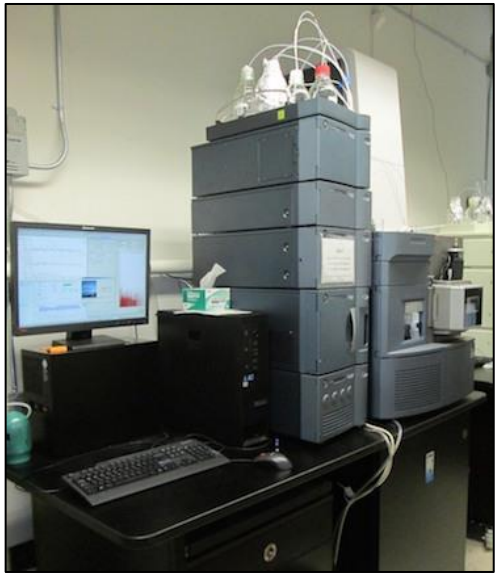
Metabolite extraction: methanol: chloroform: water (5:2:2) protocol[2]

Tissue homogeneization

Extract SpeedVac desecation

Metabolites methanol reconstitution

UHPLC/qTOF- MS analysis (UPLC Acquity H-Class Xevo G-2)



Identification and Quantification

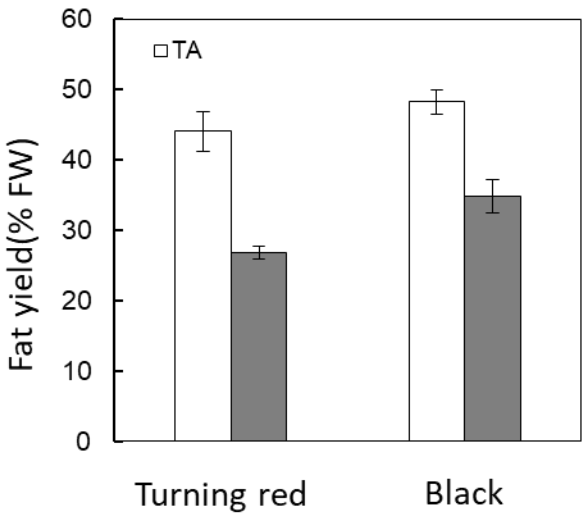
Spectra analyses

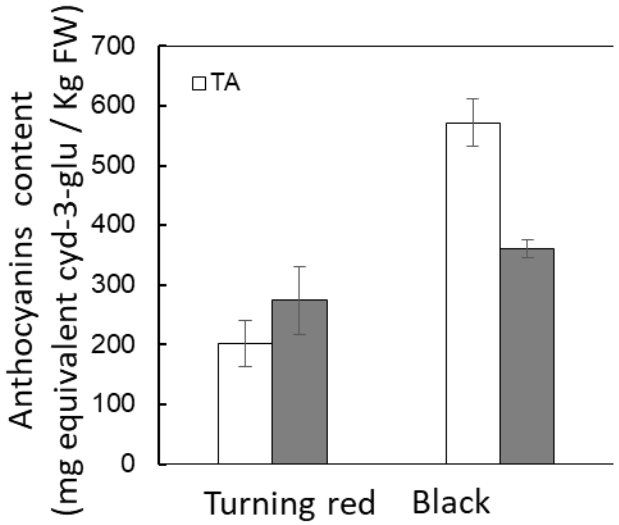
Statistical analysis

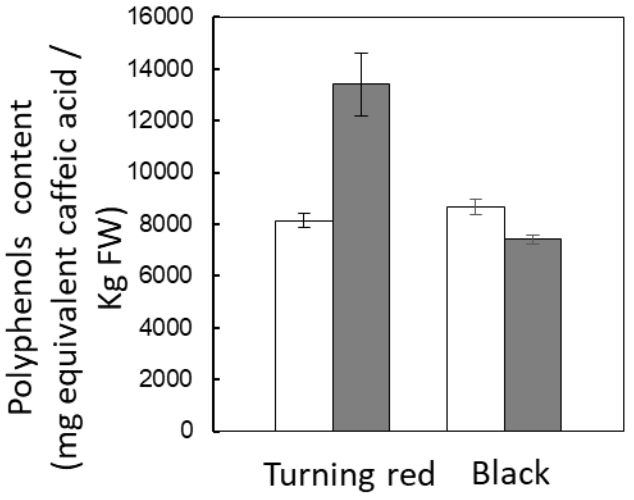
[2] Valledor et al. (2014.). *Plant J.* 79, 173–180

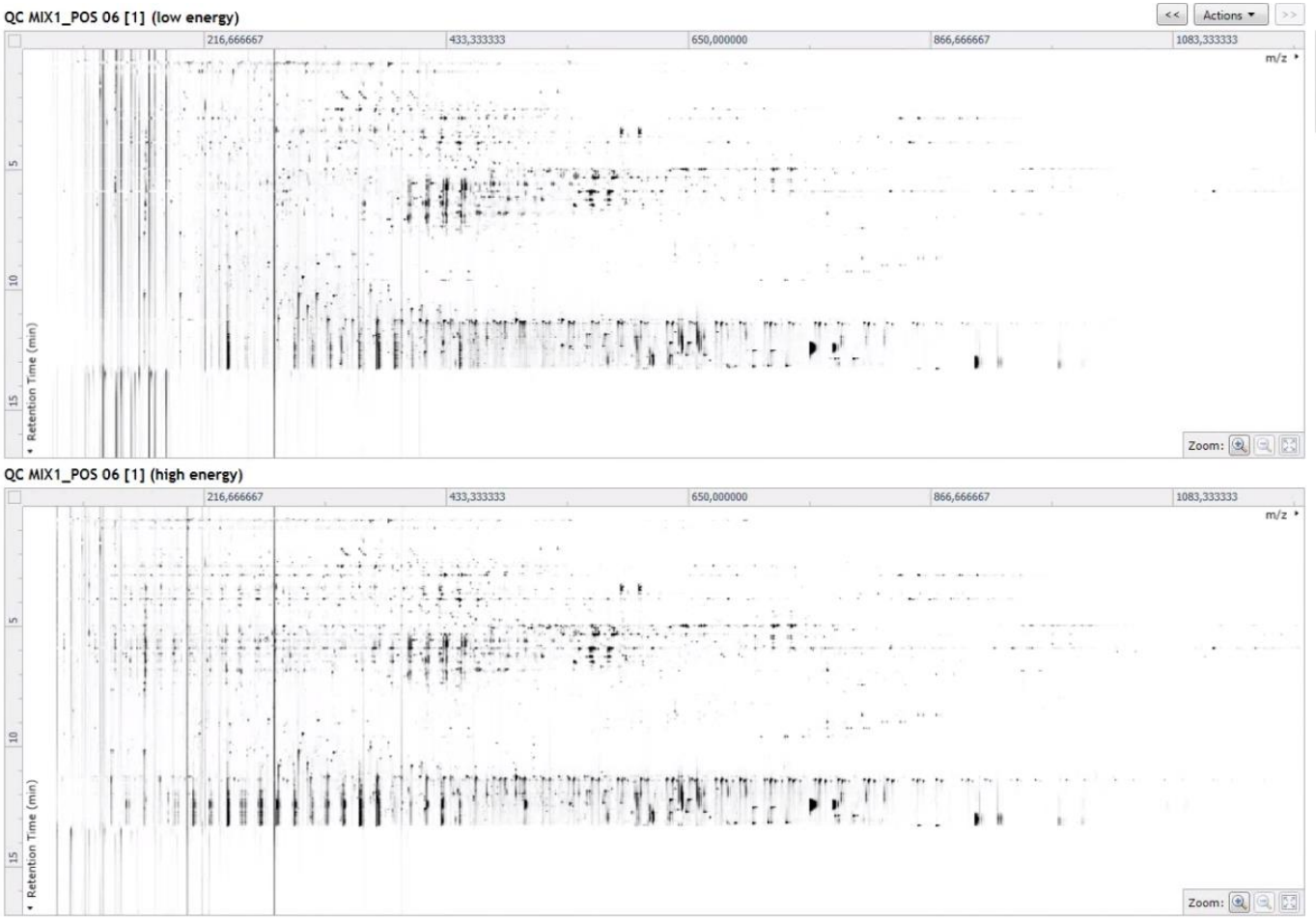
Results

	Perfect Flowers (%)	Total Production/tree (Kg FW)	Fruit size (g FW/nº fruits)	Pulpe/pit (g FW/g FW)	Fat yield (% DW)
AT	6.0 ± 1.4 a*	5.8 ± 0.7 a**	5.7 ± 0.1 a**	9.0 ± 0.3 a**	54 ± 1 a*
AT+4ºC	0.5 ± 0.2 b*	0.3 ± 0.0 b**	3.2 ± 0.2 b**	3.7 ± 0.3 b**	36 ± 5 b*

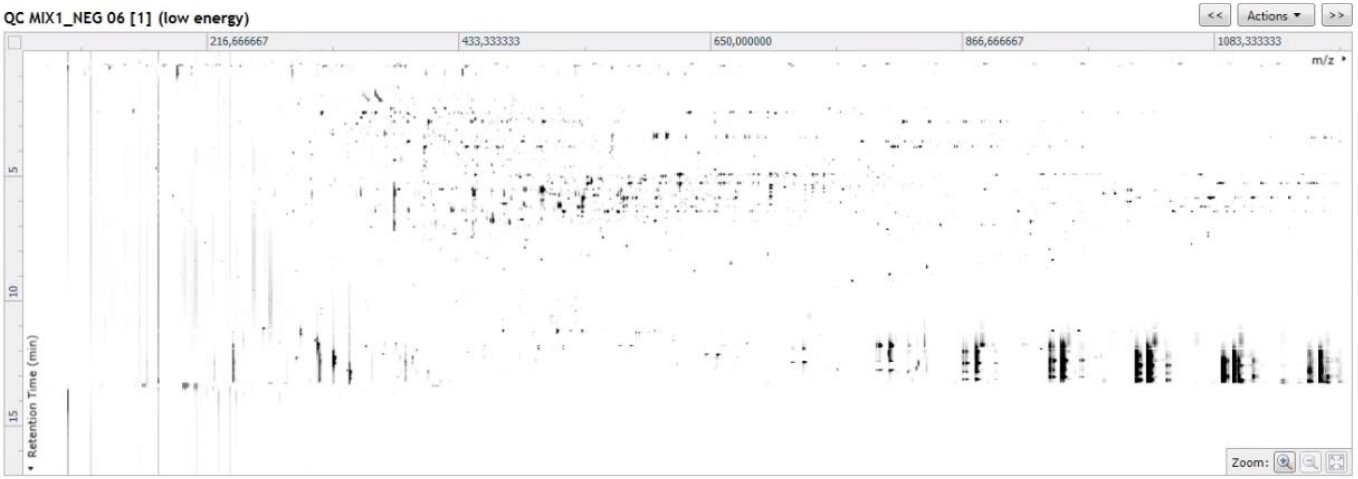




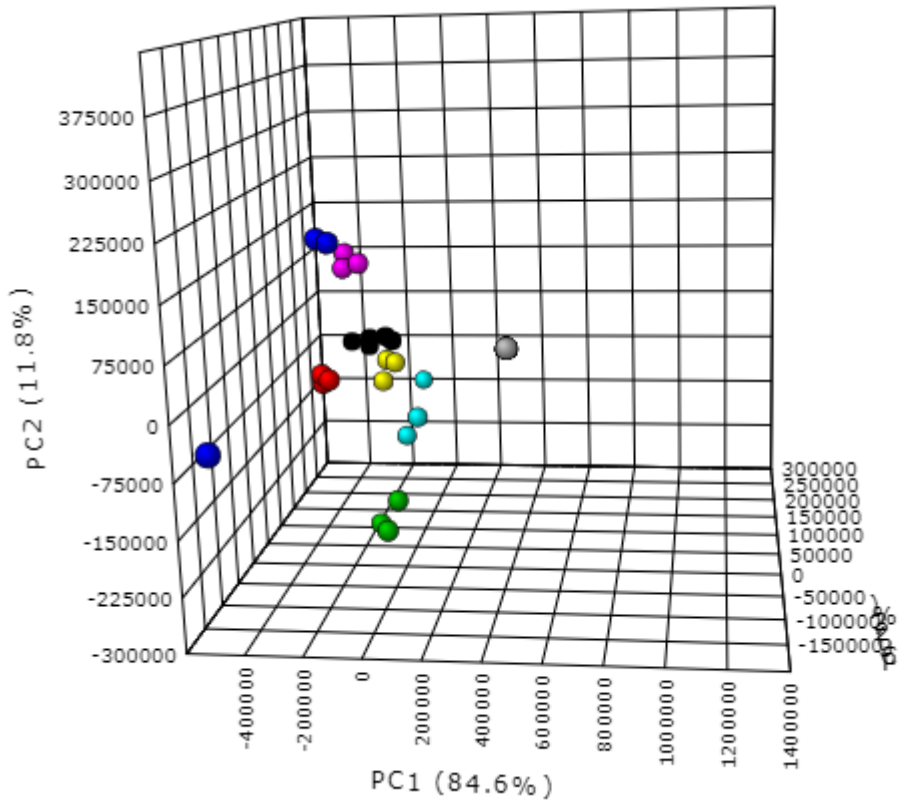


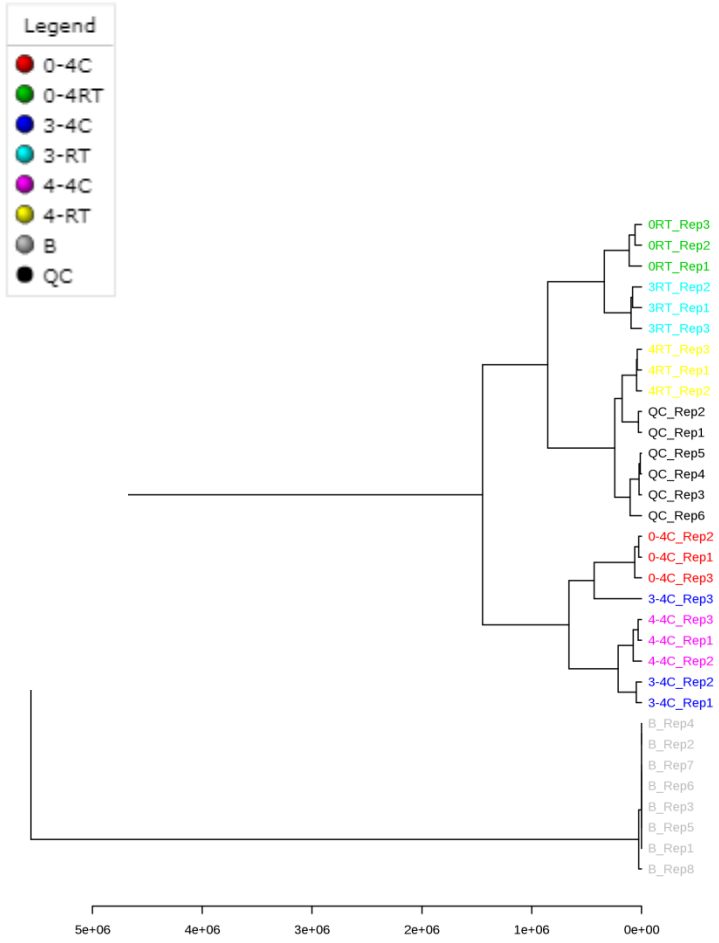


~ 97.000 signals
9877 annotated compounds
~700 metabolites identified



~ 49.000 signals
1162 annotated compounds
~290 metabolites identified


375000
300000
225000
150000
75000
0
-75000
-150000
-225000
-300000
PC2 (11.8%)
-400000
-200000
0
200000
400000
600000
800000
1000000
1200000
1400000
PC1 (84.6%)
300000
250000
200000
150000
100000
50000
0
-50000
-100000
-150000


Legend
0-4C
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3-4C
3-RT
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B
QC
0RT_Rep3
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3RT_Rep2
3RT_Rep1
3RT_Rep3
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4RT_Rep2
QC_Rep2
QC_Rep1
QC_Rep5
QC_Rep4
QC_Rep3
QC_Rep6
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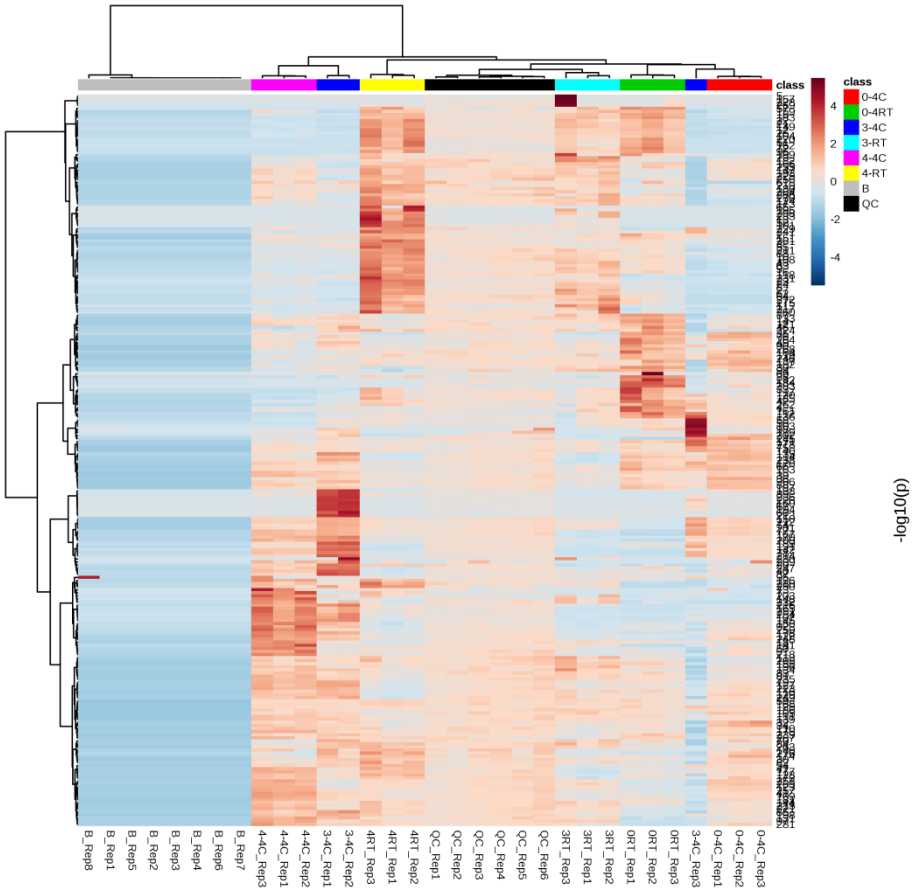

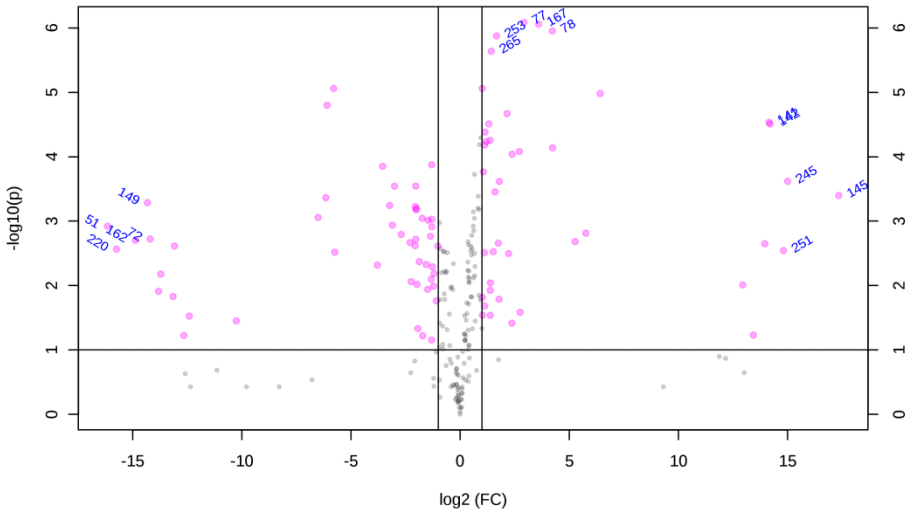

193 metabolites were differents at green ripening stage
Fold Change |2|

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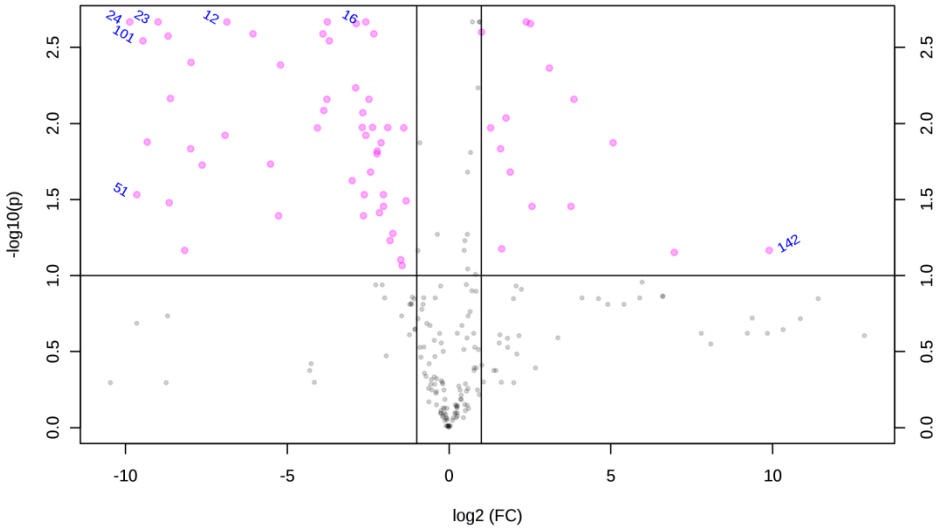
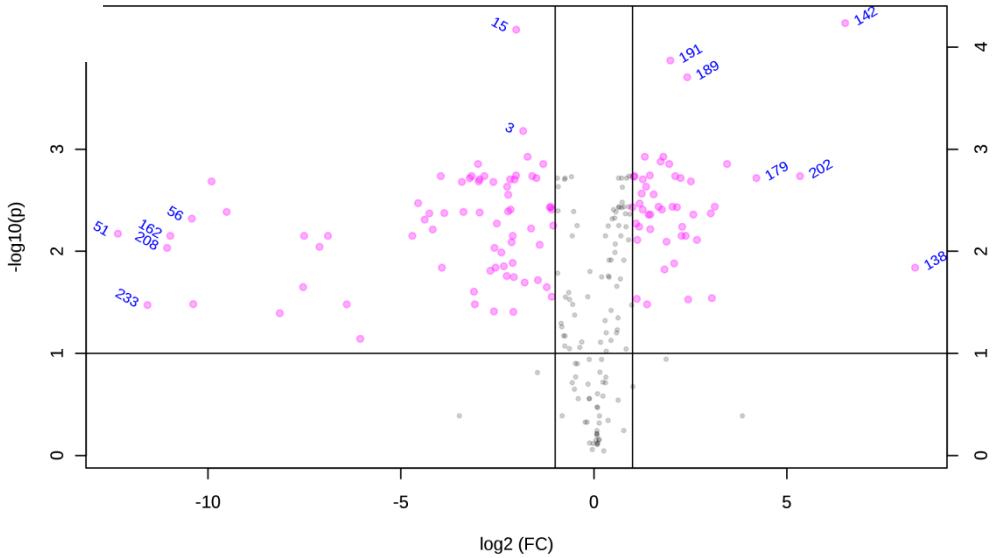


177 metabolites were differents at turning-red ripening stage
Fold Change |2|

241 metabolites were differents at purple ripening stage
Fold Change |2|



Functional categorization was carried out manually

Conclusions

- Around 800 metabolites were identified by UHPLC/qTOF MS strategy using a restricted parameters.
  - Present in 2/3replicates and absent in blank
  - With description known and fragmentation spectra
  - Quality control reproducibility
- Around 200 metabolites/ripening stage present differences (FDR<0,05) between AT and AT+4ºC treatments.
- The major ripening processes affected by +4ºC were fatty acids synthesis, plant cell wall degradation, and terpene, phenylpropanoids and flavonoids biosynthesis.
- The results suggest that global warming will be affect the ripening processes modifying the fruit characteristics and the final oil quantity and quality.

Perspectives

- **Analysis by RT-qPCR of 103 gene expressions**
  - Lipid metabolism
  - ABA- ethylene-AIA response
  - Plant wall degradation
  - Anthocyanin biosynthesis
  - Olive secondary metabolites
- **Analysis of flowering and ripening processes by proteomics assays**
- **Extension of the study with other varieties**

ECOBIO Rennes

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IFAPA Instituto de Investigación y Formación Agraria y Pesquera

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Thanks for your attention