



**UNIVERSITÀ  
DEGLI STUDI DI BARI  
ALDO MORO**



**Politecnico di Bari**

**Maria Lisa Clodoveo**

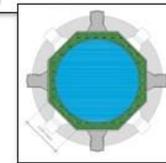
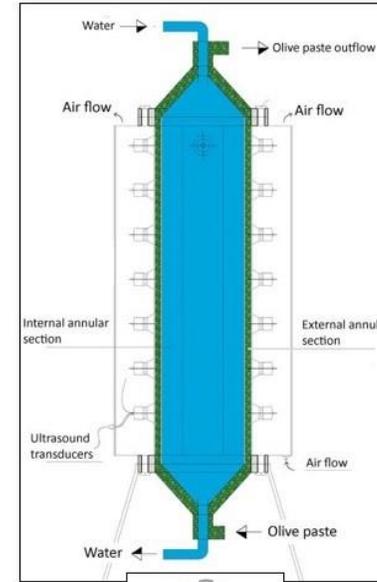
**PIU' RESA, SALUTE,  
GUSTO E  
SOSTENIBILITA':  
GLI ULTRASUONI IN  
FRANTOIO**



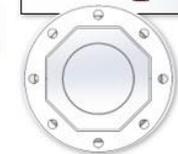
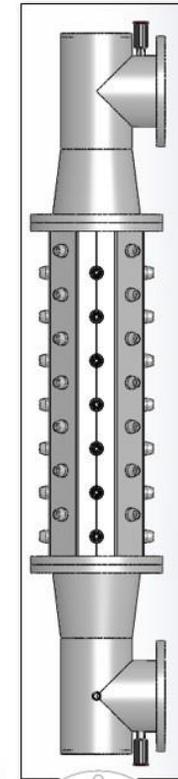
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ALDO MORO**

**Dipartimento di Studi Umanistici  
Dipartimento di Scienze Agro-Ambientali e Territoriali**

**STORIA E INNOVAZIONE  
NELLA FILIERA OLIVICOLA-OLEARIA**



**From the sketch  
to the  
3D Virtual Prototype**



**to the  
Full-Scale Device**



*Figure collegate al testo*

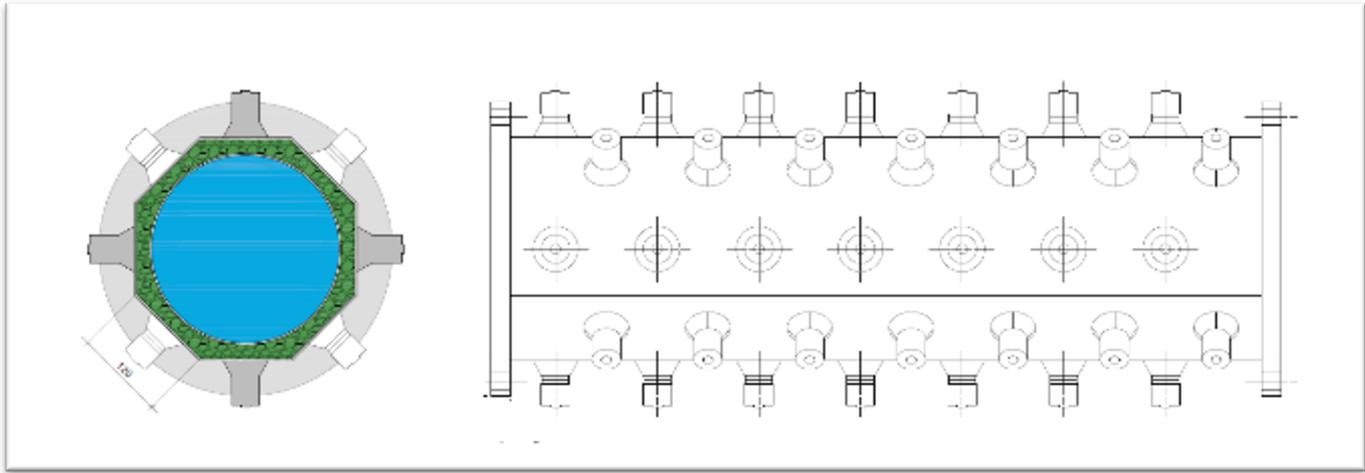


Figura 1. Il dispositivo è stato con una sezione ottagonale dotata di trasduttore a piastra, ciascuno di 100 W di potenza e 23 kHz di frequenza. La sezione circolare interna è lo scambiatore di calore. La pasta di olive scorre nella sezione anulare esterna, mentre l'acqua (fredda o calda) scorre nella sezione anulare interna per modulare la temperatura all'interno della pasta di olive.

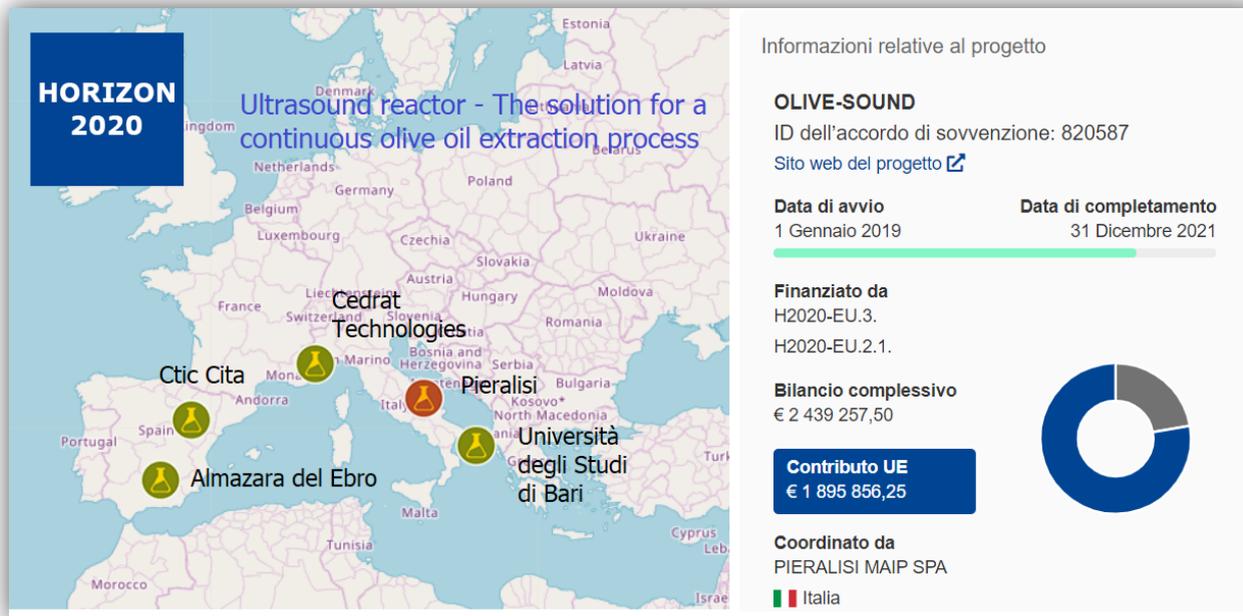


Figura 2. Composizione del partenariato del progetto 'Horizon 2020 Olive Sound'.

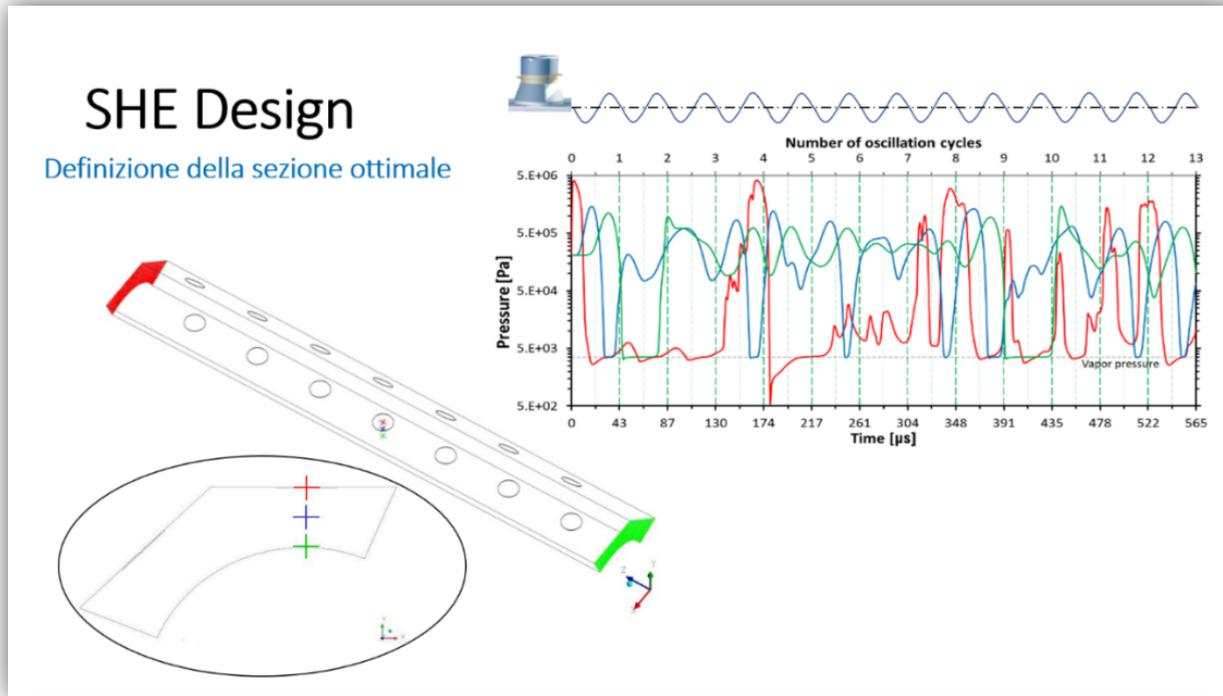


Figura 3. Determinazione dei transitori di pressione all'interno del 'Sono-Heat-Exchanger' – 'Olive Sound' indotti dalla azione degli ultrasuoni sulla pasta di olive.

# SHE Design

Analisi fluidodinamica

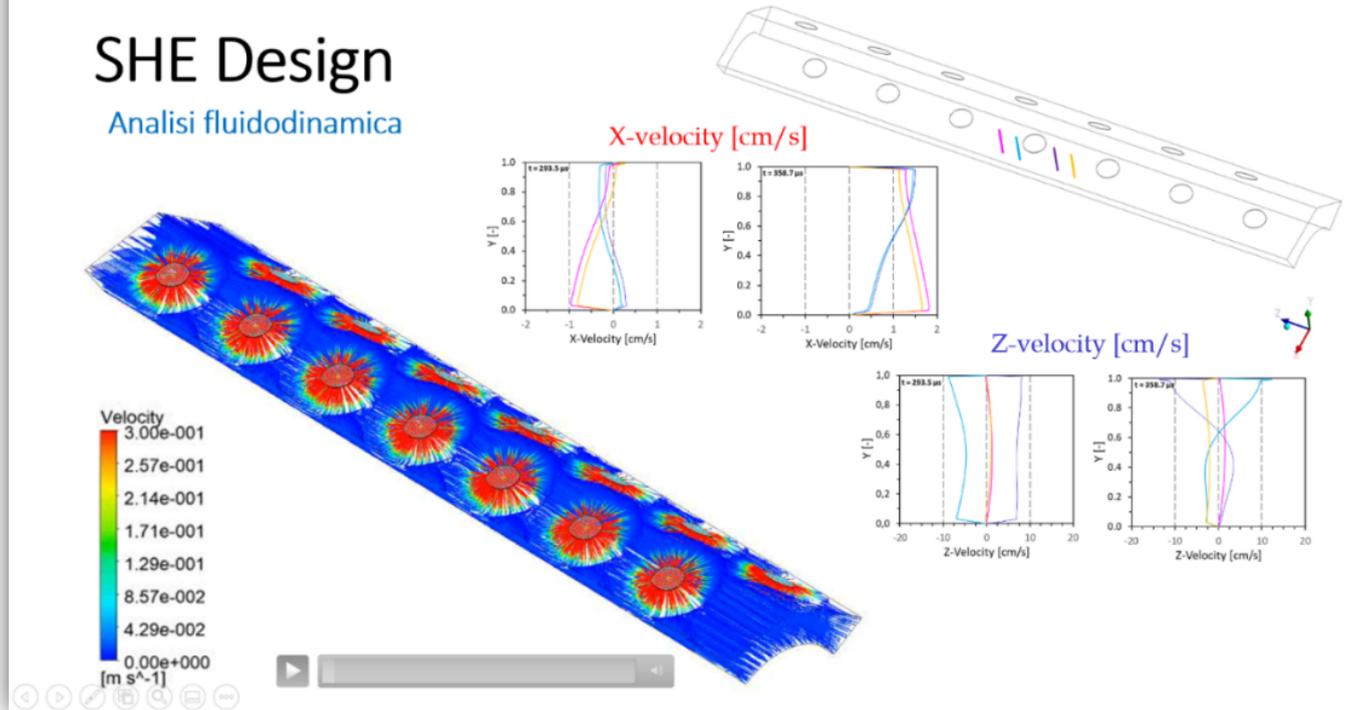


Figura 4. Analisi fluidodinamica della pasta di olive all'interno del 'Sono-Heat-Exchanger - Olive Sound'.



Figura 5. Alcune fasi della costruzione della unità modulare del ‘*Sono-Heat-Exchanger*’ – ‘*Olive Sound*’ costruita per i test di ottimizzazione.

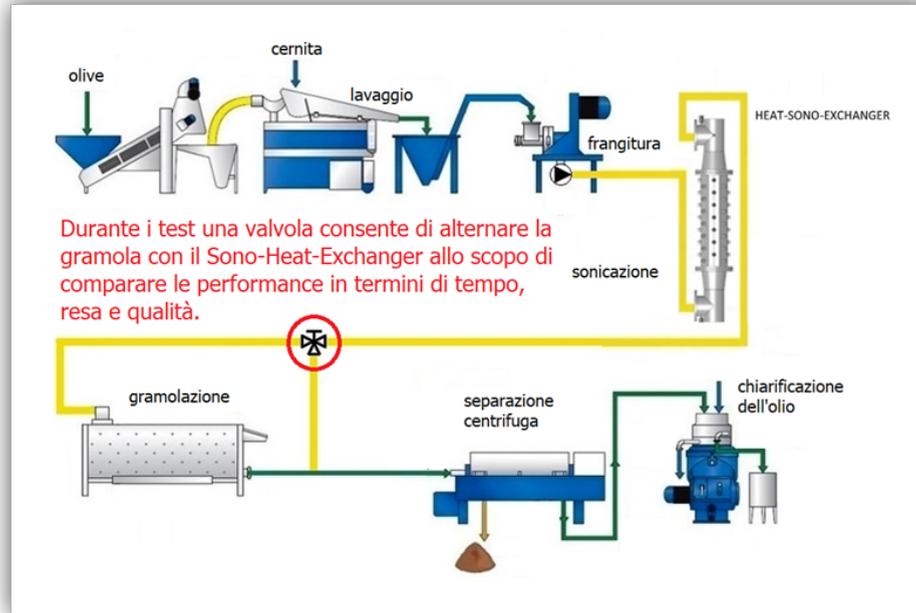
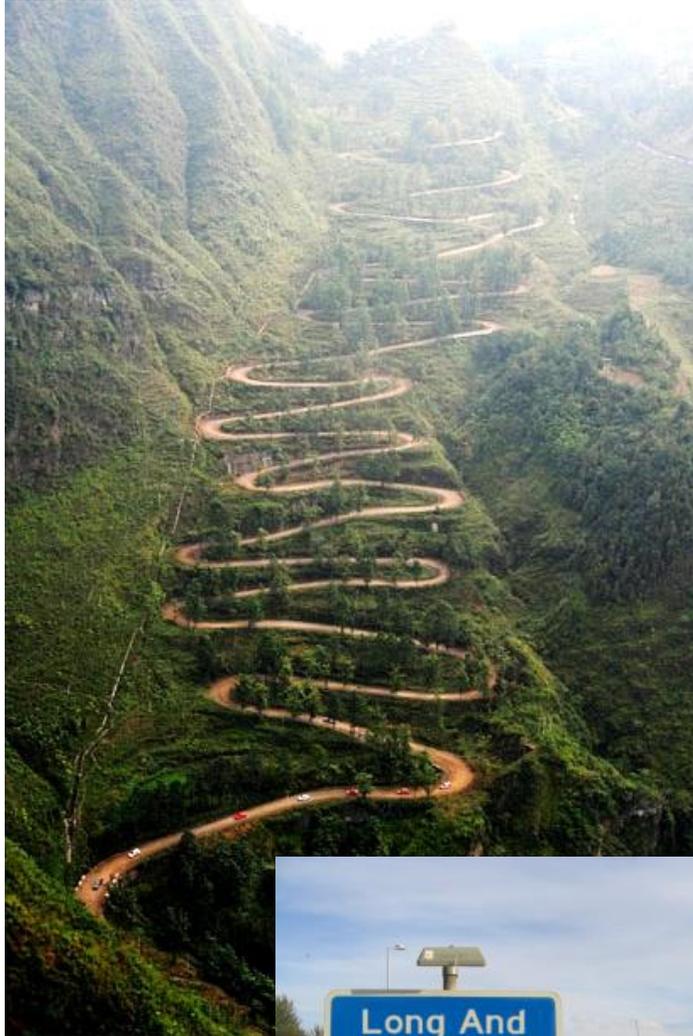


Figura 6. Schema di montaggio del prototipo nei test di verifica funzionale.





**con** **i** **minuti** **contati**



Grazie per  
l'attenzione



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mobile phone: 0039 334 605 3 605

**Conversion of research results to industrially useful innovations is, however, considerably more complex than generally appreciated.**



Idea Generation



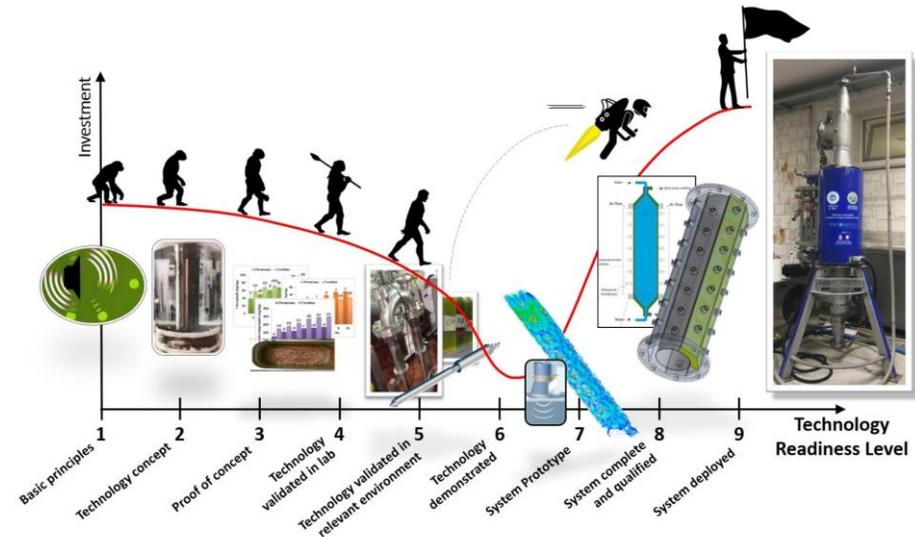
Selection



Execution



Launch to Market



# NUOVO QUATTORRUOTE

PROVE SU STRADA  
CON INEDITE ANALISI  
ANCORA PIÙ APPROFONDITE  
GRAFICA  
INTERAMENTE  
RINNOVATA

IN PROVA  
**VOLKSWAGEN  
POLO**

MASERATI  
RENAULT  
MAZDA  
TOYOTA  
SUZUKI



FCA IL FUTURO DEL GRUPPO FRA AVANCES CINESI E ALLEANZE EUROPEE  
OFFERTE KM O DELLE CASE PREMIUM: ECCO QUANTO SI RISPARMIA

**GIORGETTO GIUGIARO**  
VI RACCONTO  
I SEGRETI MOTIVI  
DELLA VENDITA  
DI ITALDESIGN  
**FRANCOFORTE**  
TUTTE LE NOVITÀ  
DEL SALONE  
TEDESCO

**HURACÁN PERFORMANTE**  
NUOVO RECORD DELLA PISTA  
E LEI LA REGINA DI VERRANO!



**FERRARI**  
TENTAZIONE SUV  
PER IL CAVALLINO

# NON è

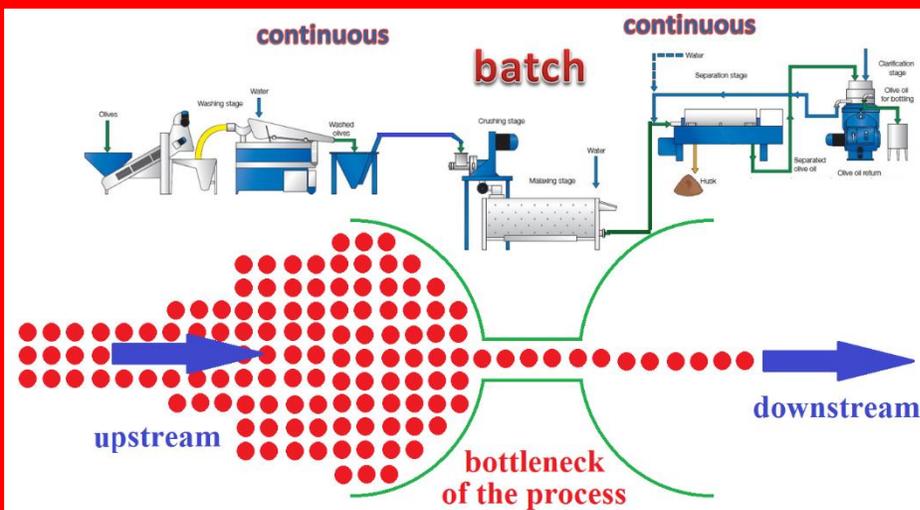
# Test Drive



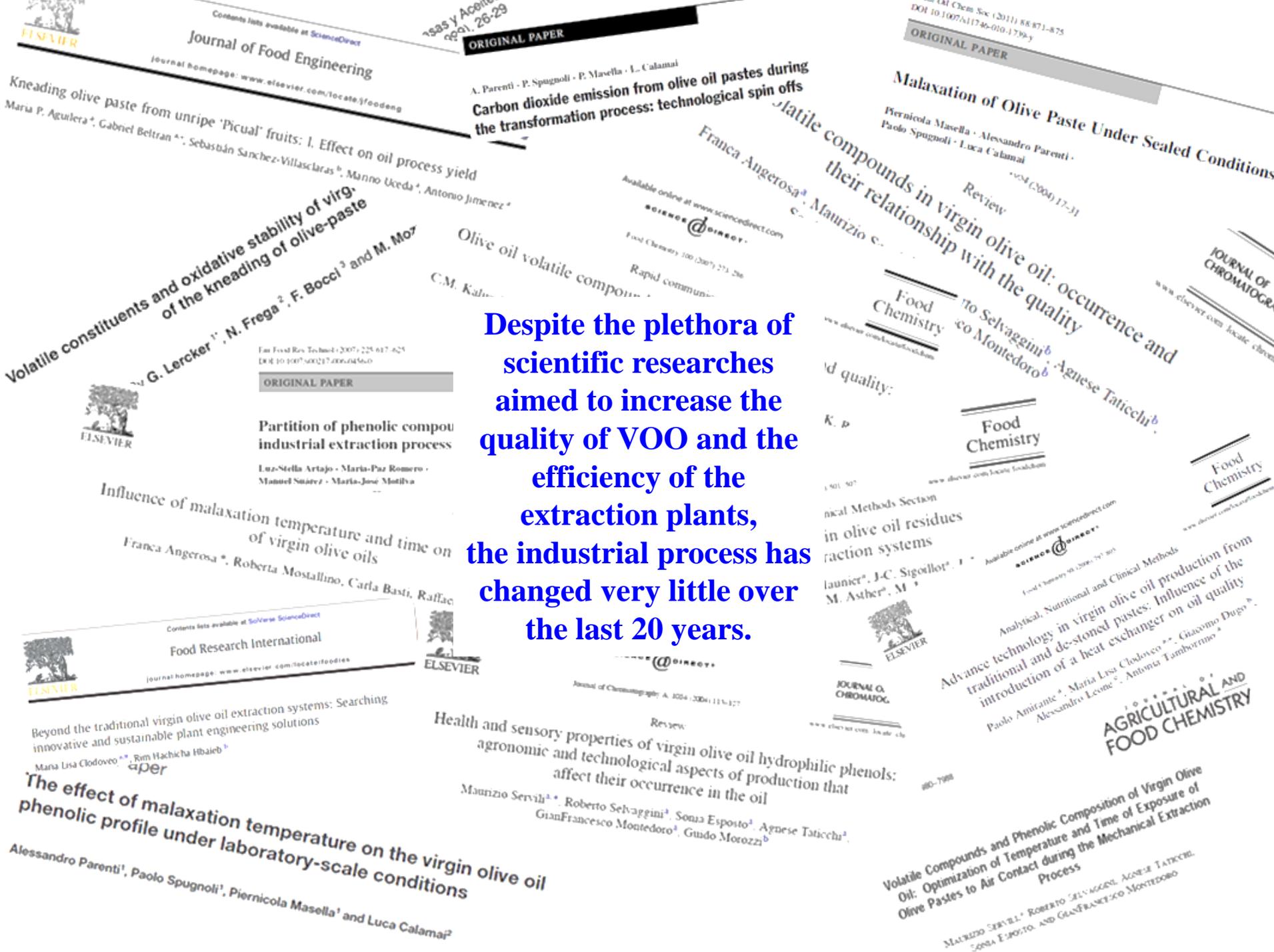


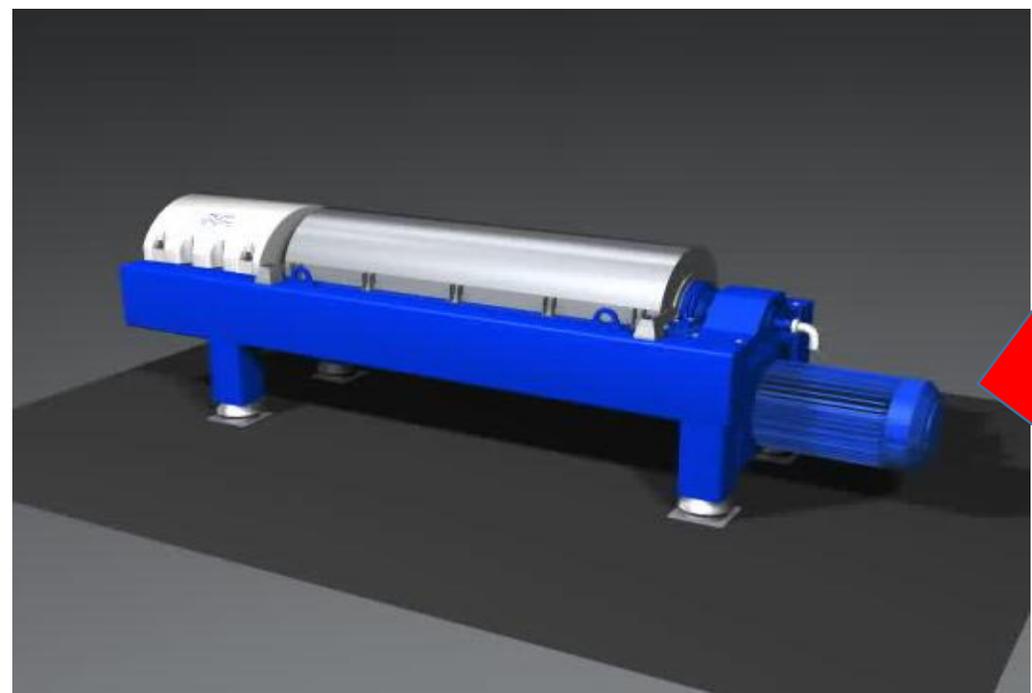
## «demand-pull»....

Un modello di innovazione che nasce dalla necessità di SODDISFARE UN BISOGNO ESPLICITO dell'industria olearia



Despite the plethora of scientific researches aimed to increase the quality of VOO and the efficiency of the extraction plants, the industrial process has changed very little over the last 20 years.



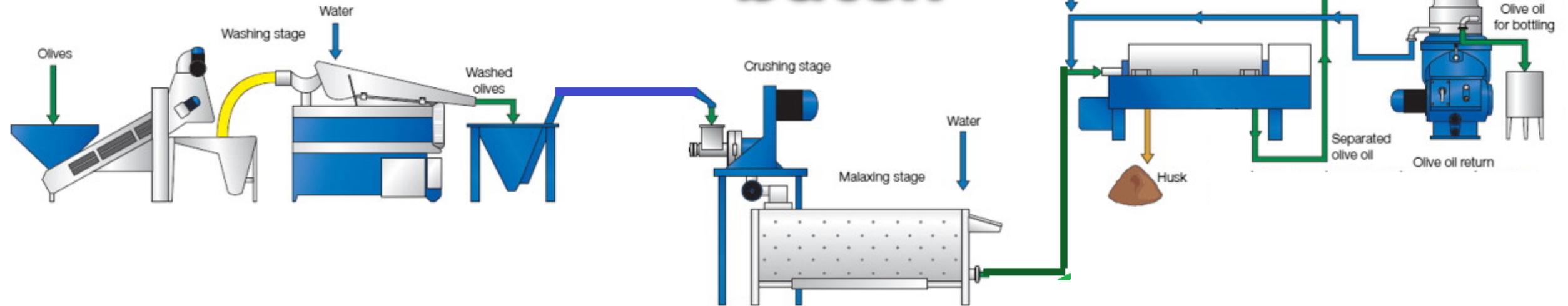


# Impianti in “continuo”

continuous

batch

continuous

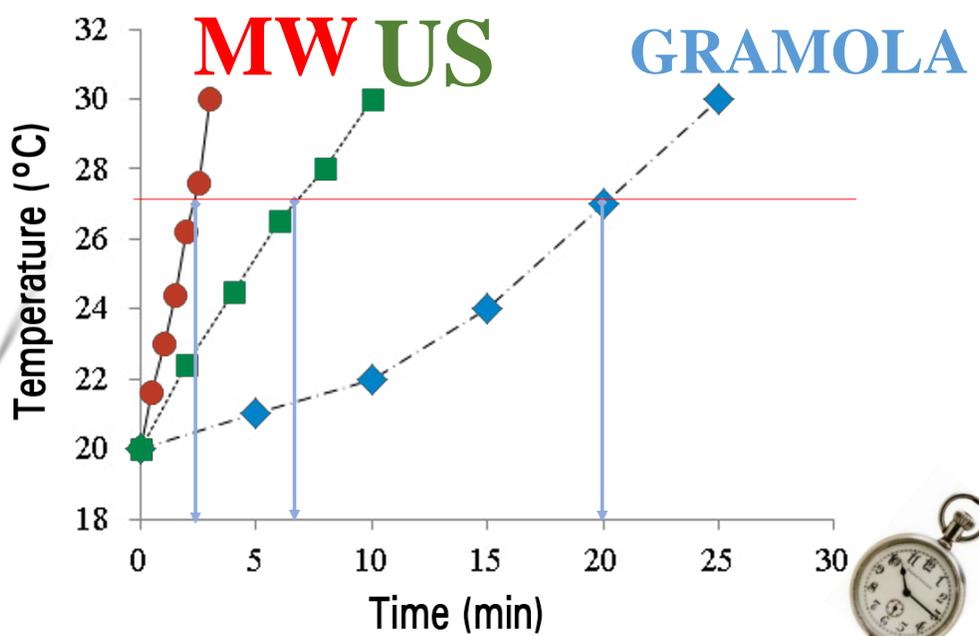




**SOLUZIONE ATTUALE:  
numerose gramole in  
serie o in parallelo**

# 2012

**ULTARSUONI**  
**contro**  
**MICROONDE**



FRANGITURA  
2,5 kg di olive



RISCALDAMENTO  
TRADIZIONALE



MICROONDE



ULTRASUONI

# LA RIVOLUZIONE

In regime di stampa imbavagliata il vero articolista è il lettore: egli deve leggere tra le righe.

## 2012

CONTO  
CORRENTE  
POSTALE

RIVISTA STORICA SETTIMANALE DI POLITICA

ESCE

IL

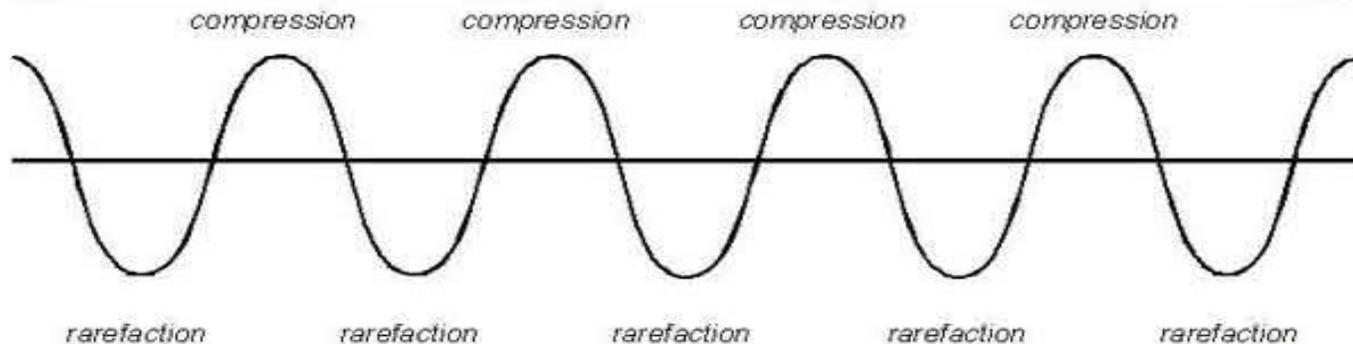
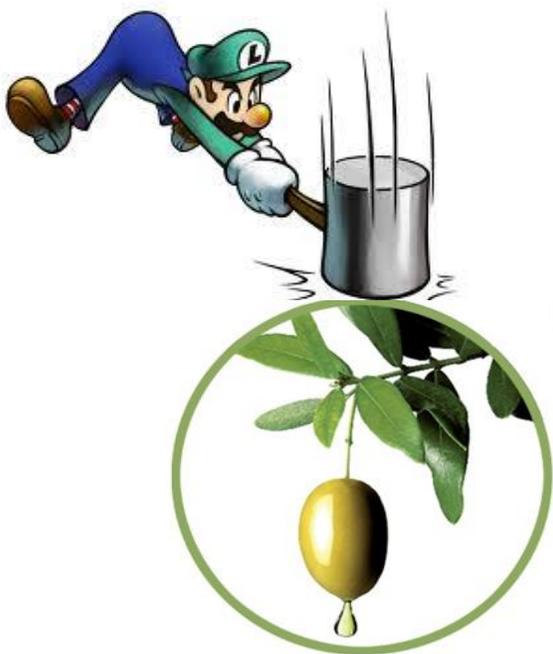
MARTEDÌ

Diretta da PIERO GOBETTI - Redazione e Amministrazione: TORINO, Via XX Settembre, 60

Abbonamento per il 1924 L. 20 - Per un semestre L. 10 - Estero L. 30 - Sostenitore L. 100 - Un numero L. 0,50

Chi riceve un numero di saggio e non intende abbonarsi restituisce il giornale, altrimenti gli continueremo l'invio e dopo un mese provvederemo alla riscossione mediante tratta

# ULTRASUONI



Gli ultrasuoni sono **ONDE SONORE** con frequenze superiori al limite udibile dell'udito umano.

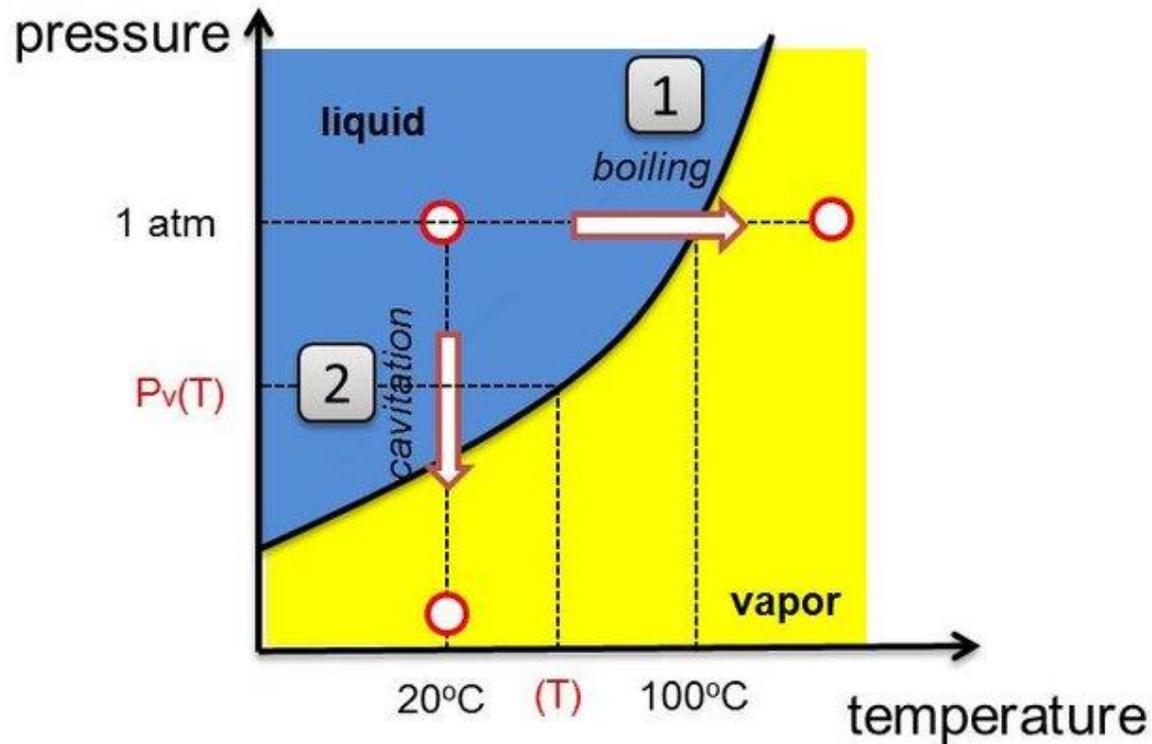


I dispositivi a ultrasuoni funzionano con frequenze da 20 kHz a qualche GHz.

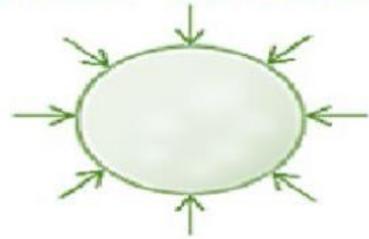
# Effetto della cavitazione

«La **cavitazione** è un fenomeno consistente nella formazione di zone di vapore all'interno di un liquido»

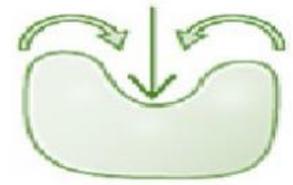
## La Cavitazione negli U.S.



micro-bubble



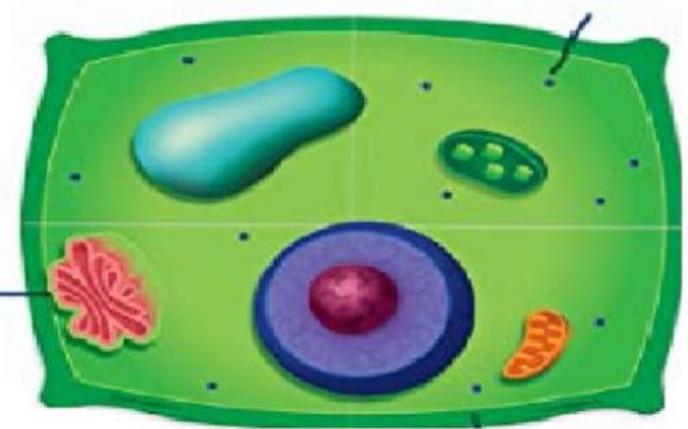
initial collapse



jet of liquid



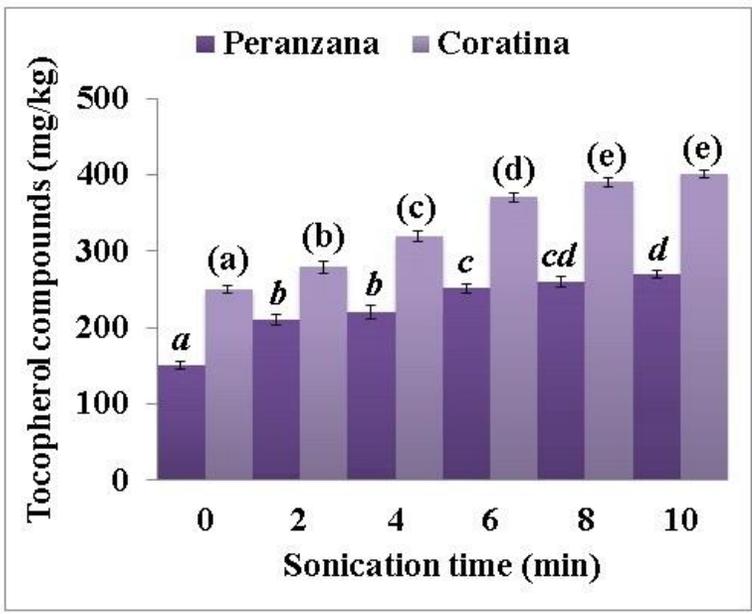
# cavitation cell rupture



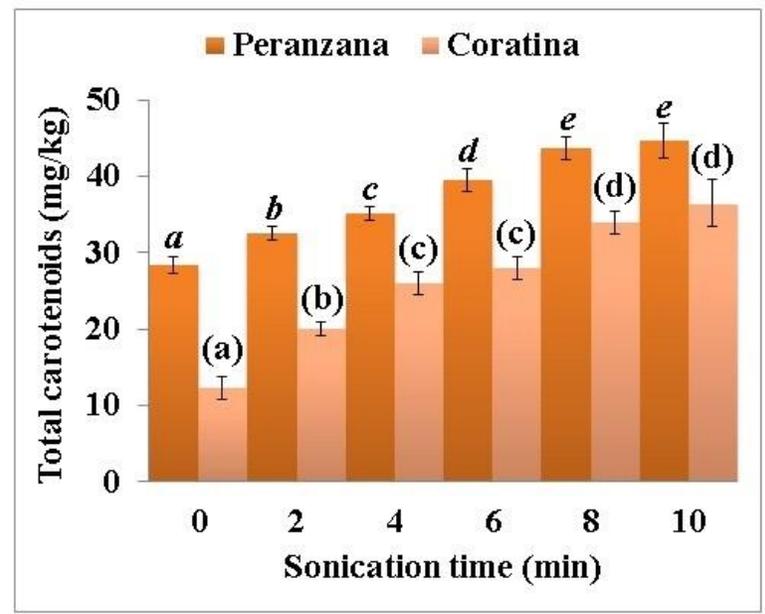
# ULTRASUONI



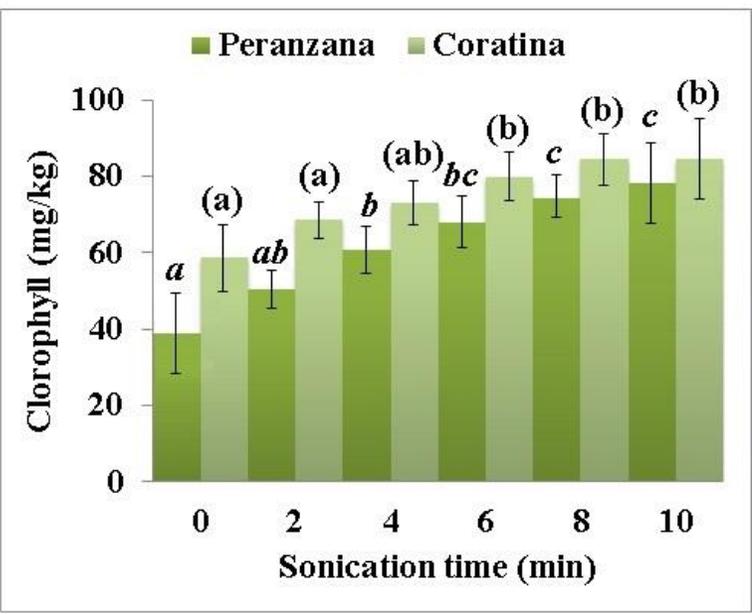
# 2012



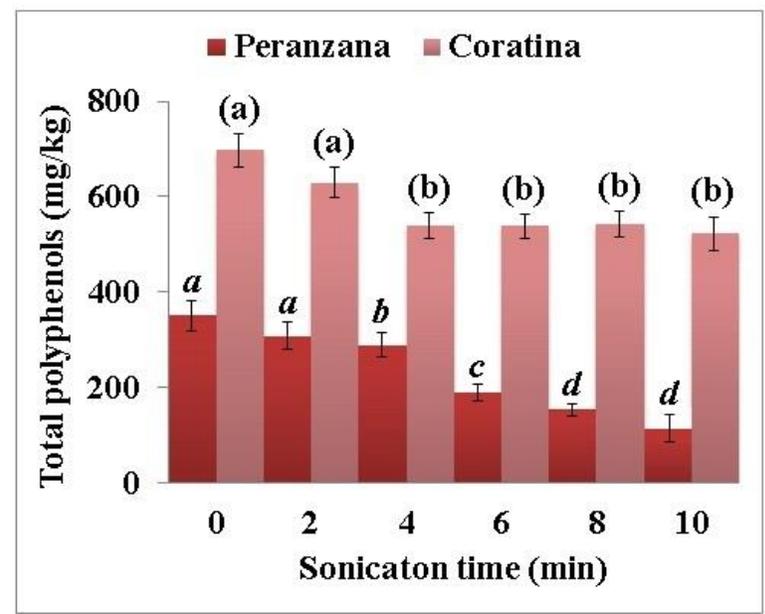
A



B

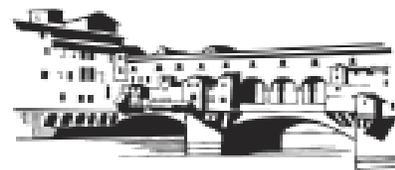


C



D

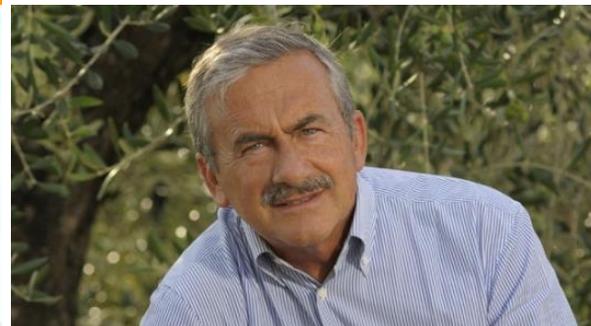
2013



FRANTOIO DI SANTA TÈA®

REGGELLO - FIRENZE

*Casa fondata nel 1426*



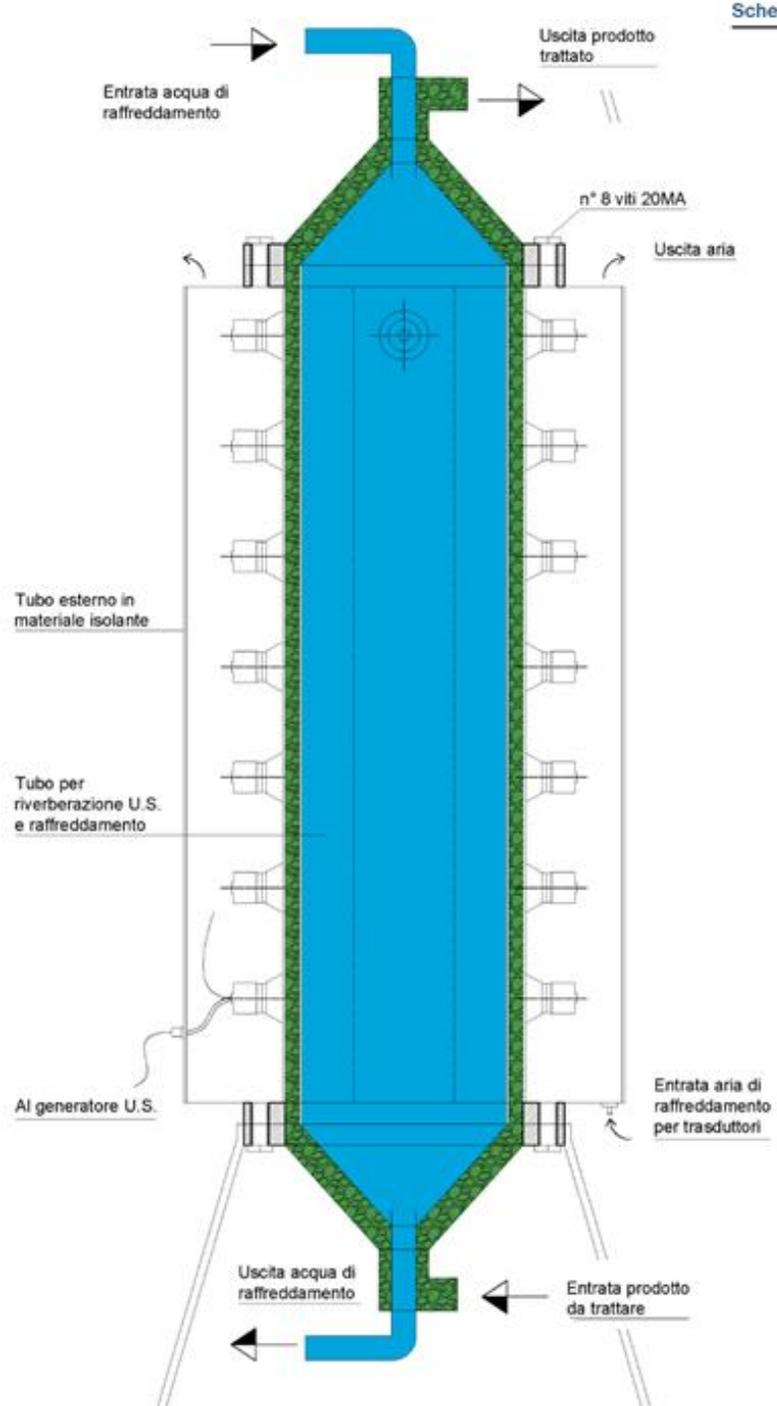
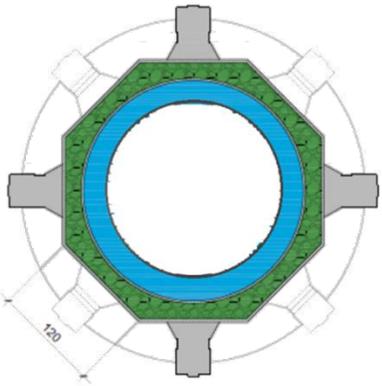
2012



# ULTRASUONI

Treatment	RESA (%)		
	mv	SD	
Nessun trattamento	16.2	±0.3	a
US per 4 minuti	16.8	±0.5	ab
US per 8 minuti	17.2	±0.3	b

# Prototipo 2016



Schema applicazione



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Cluster Tecnologici Regionali

Per l'innovazione – cod. LPU9P2



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# SONO HEAT EXCHANGER



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2016

# ENERGIA SPECIFICA



$$L_i = \frac{P_{us} * t}{m}$$

trattamento US statico			a 31 kHz	
Li (J/kg)	Ps (W)	t (sec)	m (kg)	t (min)
7200	150	120	2,5	2,0
10800	150	180	2,5	3,0
14400	150	240	2,5	4,0
18000	150	300	2,5	5,0
21600	150	360	2,5	6,0



2012



# POTENZA Prototipo PERFORMTECH 2016

$L_i = 15000 - 18000 \text{ J/kg (23 kHz)}$

$$P = \frac{G L_i}{\eta_{us}}$$



G (kg/h)	Li (J/kg)	Ps (W)
3000	15000	13889
2500	15000	11574
2000	15000	9259
1500	15000	6944
1000	15000	4630
500	15000	2315

<i>Sezione</i>	8	n.
<i>File trsd.</i>	7	file
<i>Trasdutt.</i>	56	totale
<i>Pot unit.</i>	100	W
<i>Potenza</i>	<b>5600</b>	W
<i>G</i>	1200	kg/h



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# Prototipo PERFORMTECH 2016

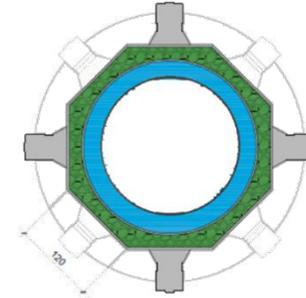


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# CFD 3D



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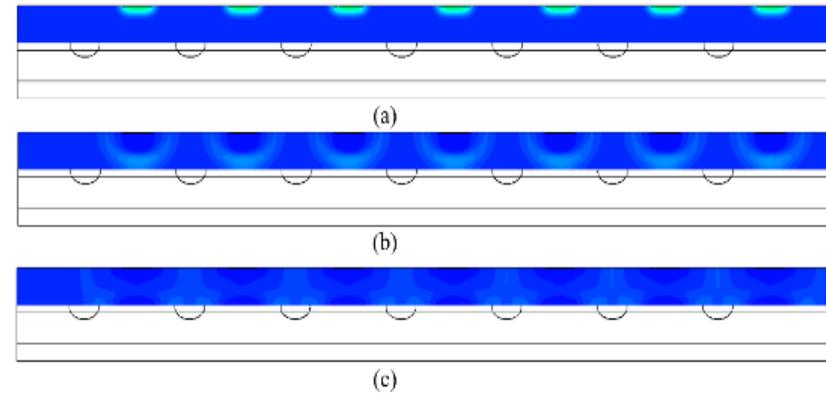
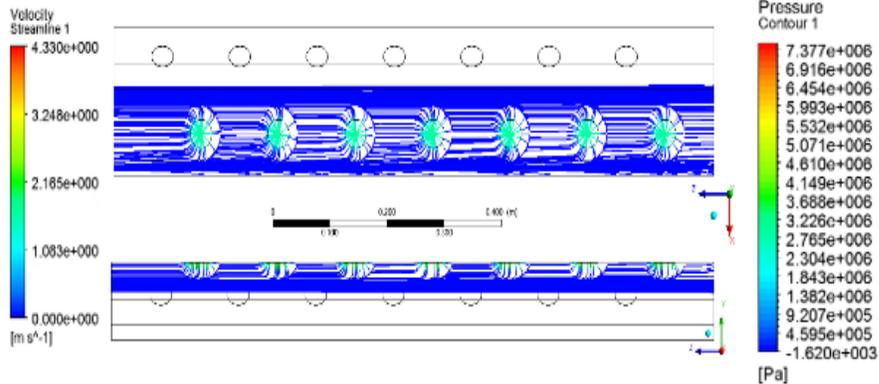
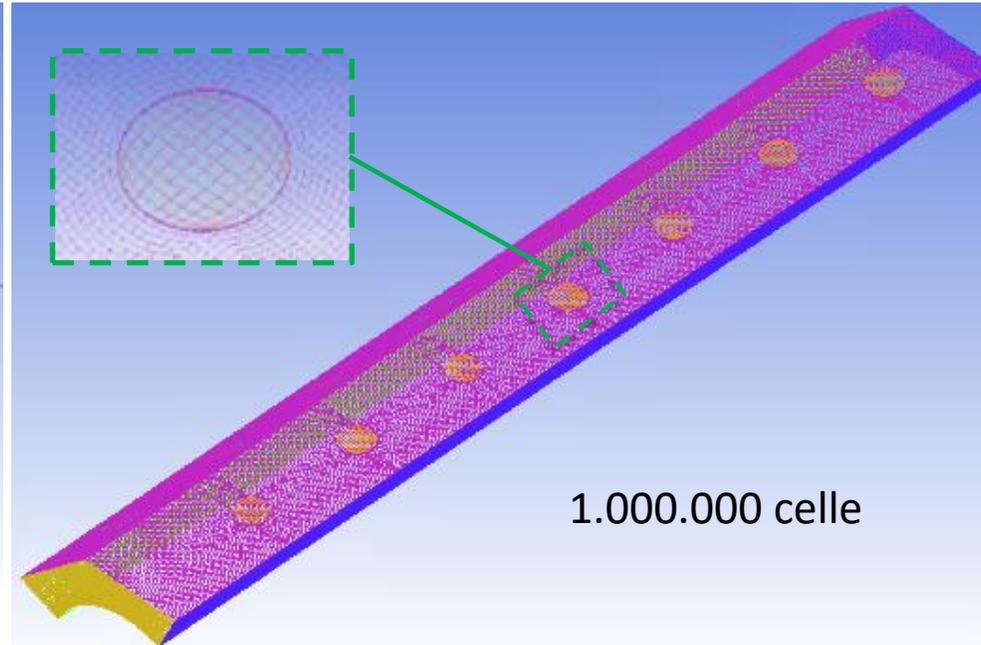
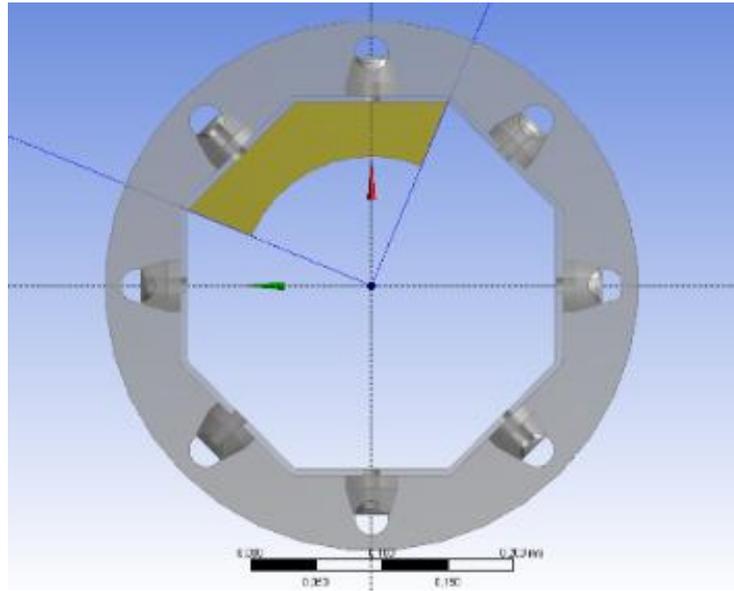
# Prototipo PERFORMTECH 2016



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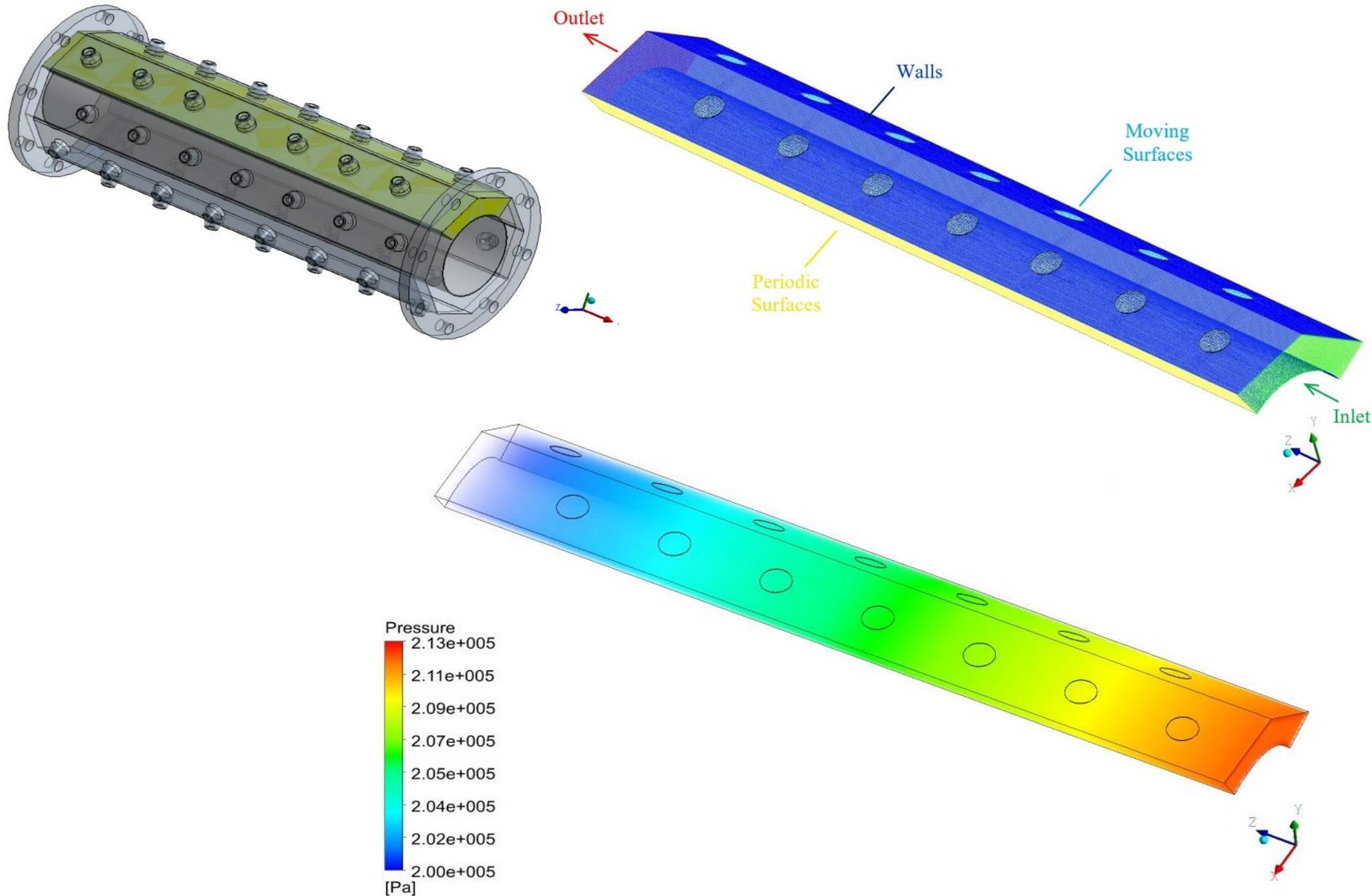


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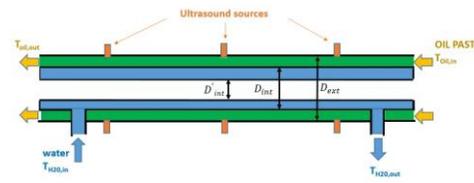
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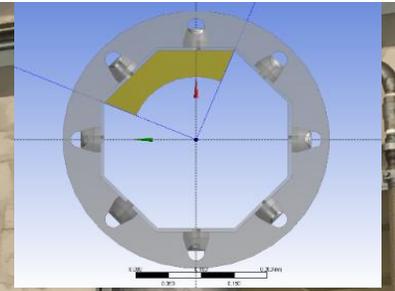
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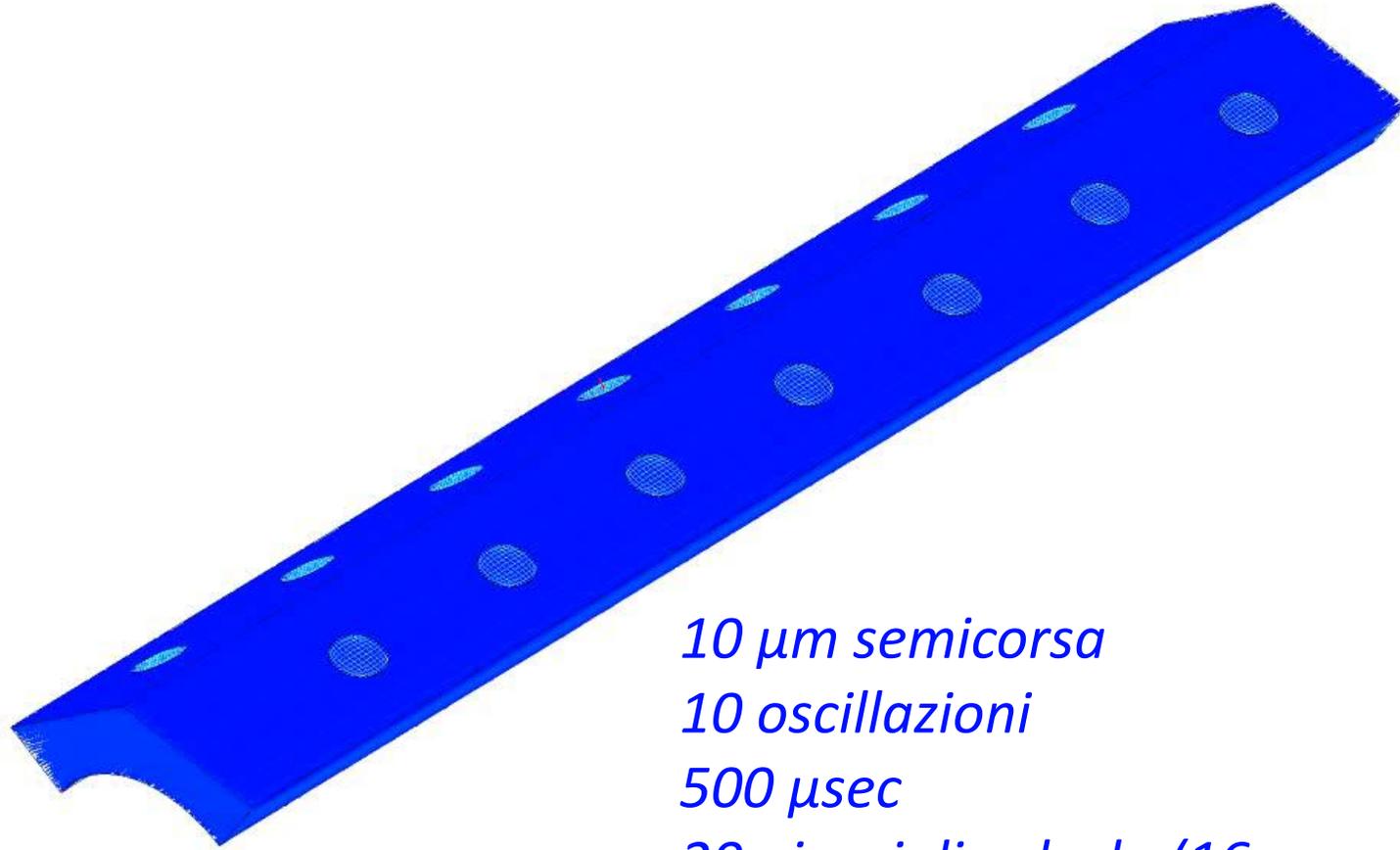
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ANSYS  
R17.2  
Academic



Velocity  
3.00e-001  
2.57e-001  
2.14e-001  
1.71e-001  
1.29e-001  
8.57e-002  
4.29e-002  
0.00e+000  
[m s<sup>-1</sup>]



*10  $\mu\text{m}$  semicorsa*

*10 oscillazioni*

*500  $\mu\text{sec}$*

*20 giorni di calcolo (16 processori)*

*Time step 10  $\mu\text{sec}$*



# 1 Frantoio (dic 2016) – Coratina



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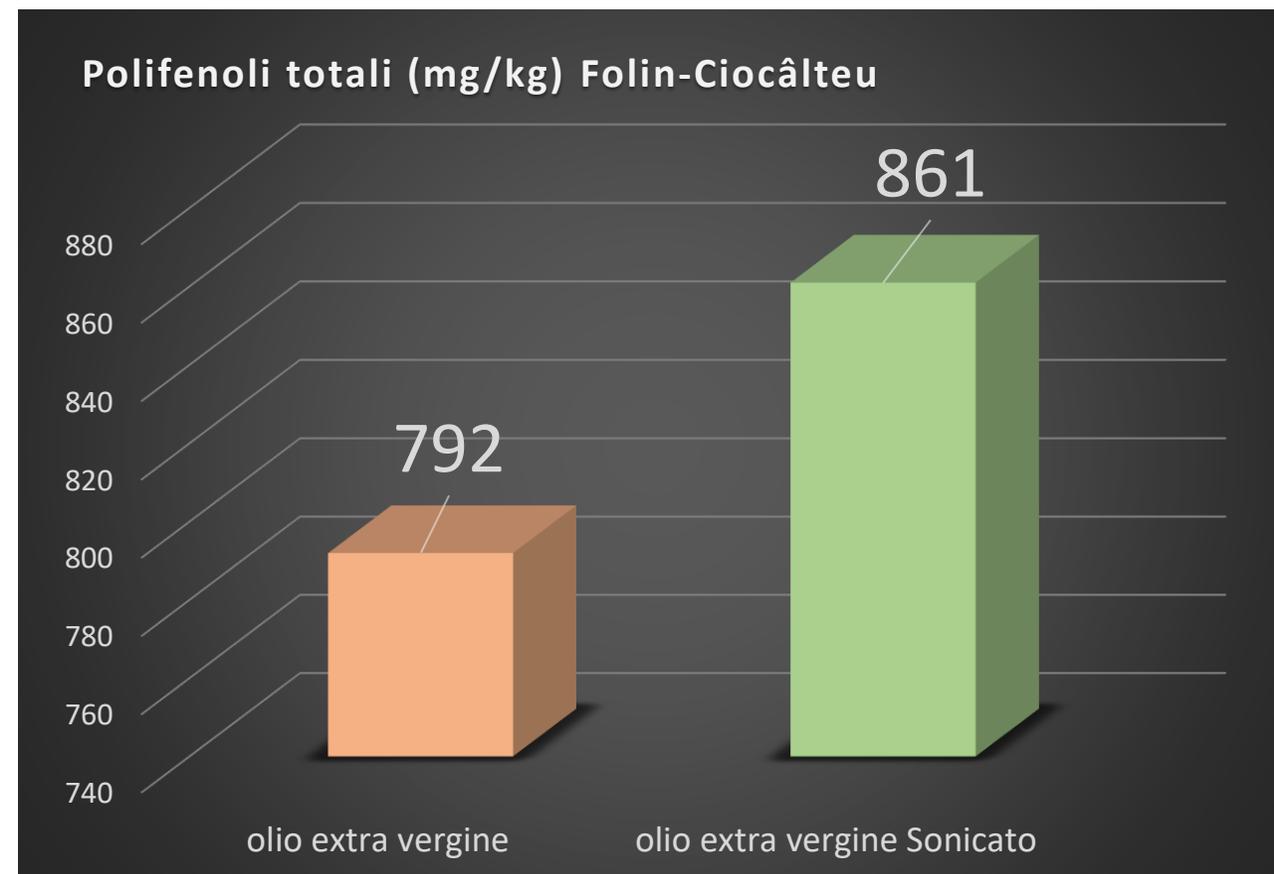
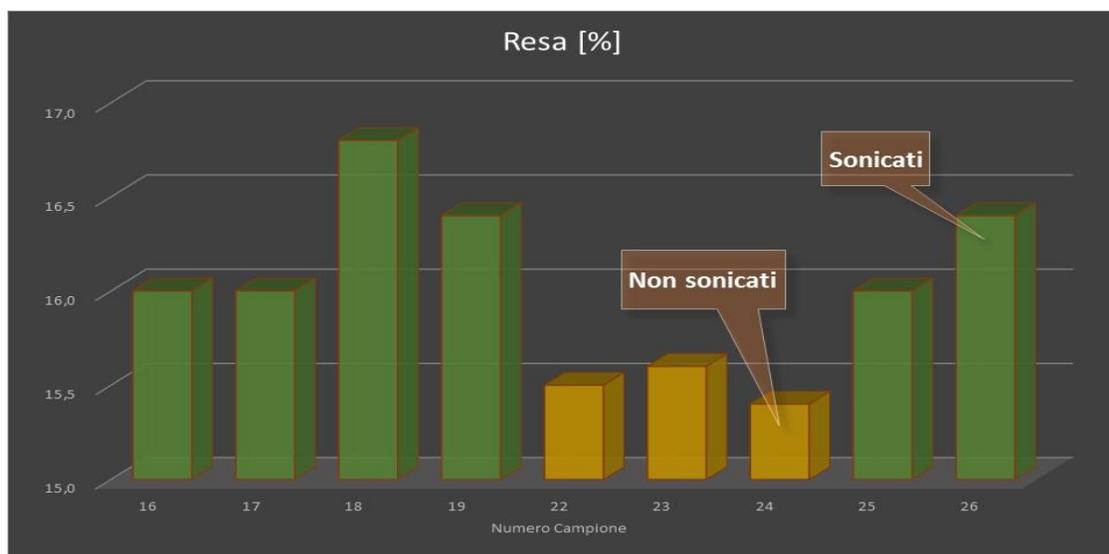


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# 2016



# *End User Validation*

- validare la tecnologia attraverso la cosiddetta *End User Validation*.
- La End-User Validation è **una fase cruciale del processo di innovazione che prevede che la tecnologia sia validata dai suoi utilizzatori finali** per verificarne:
  - l'efficacia e
  - la capacità di rispondere ai bisogni specifici di un settore.
- Il progetto dell'Istituto Nutrizionale Carapelli ha coinvolto alcuni frantoi pugliesi che hanno testato il nuovo impianto a ultrasuoni producendo olio extra vergine di oliva da cultivar differenti in epoche diverse di raccolta.



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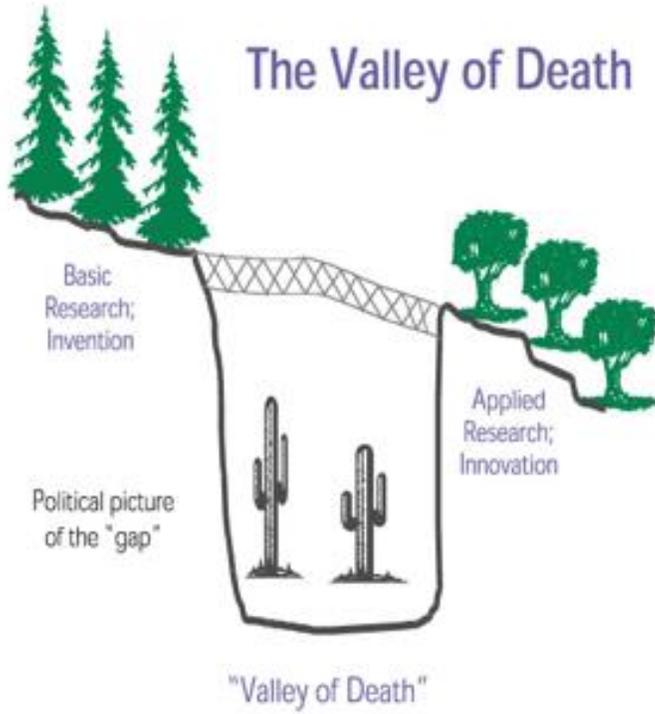


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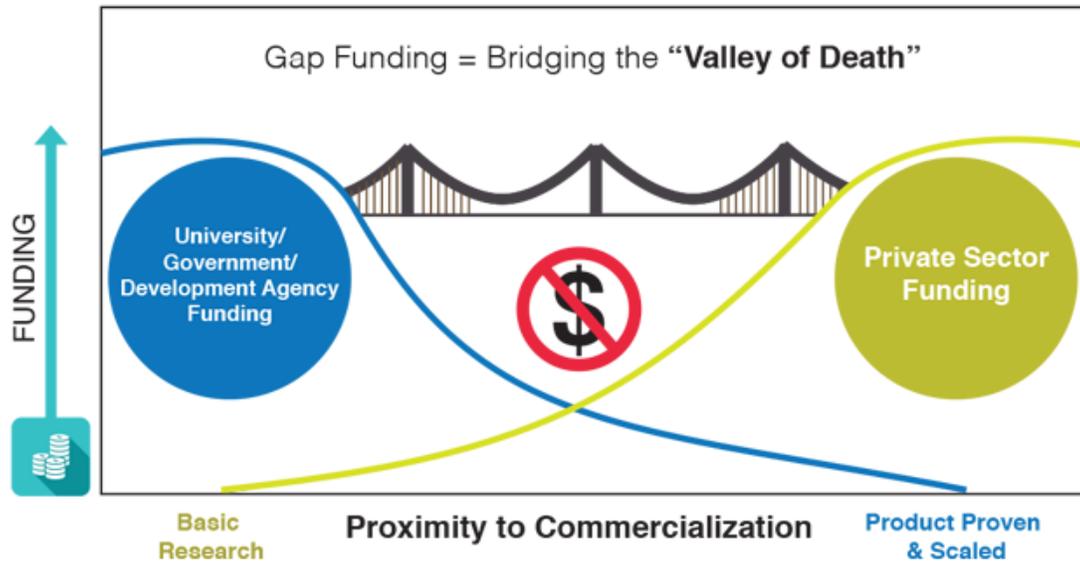
2017



# The Valley of Death



# Bridging the Valley of Death





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2017



REGIONE PUGLIA

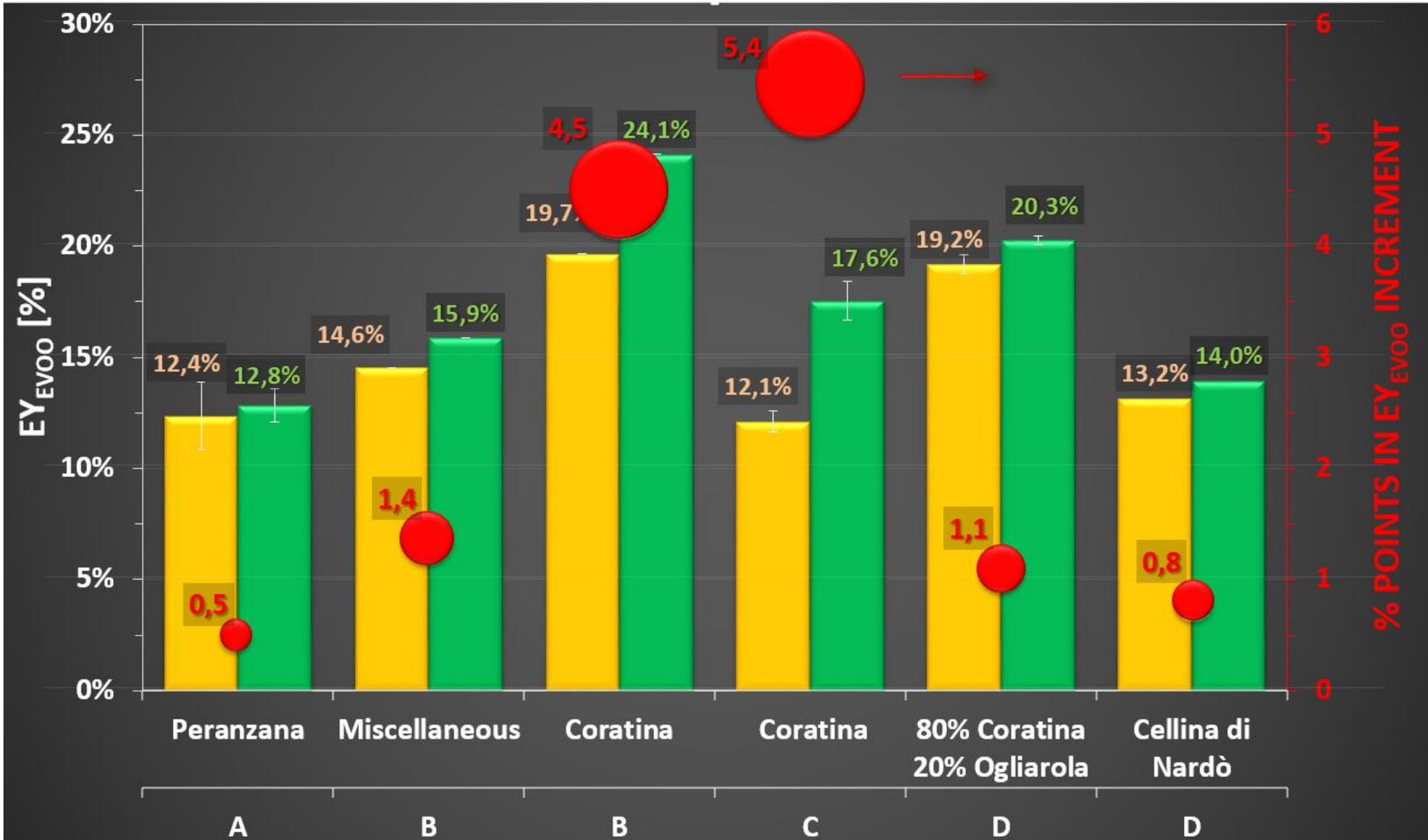


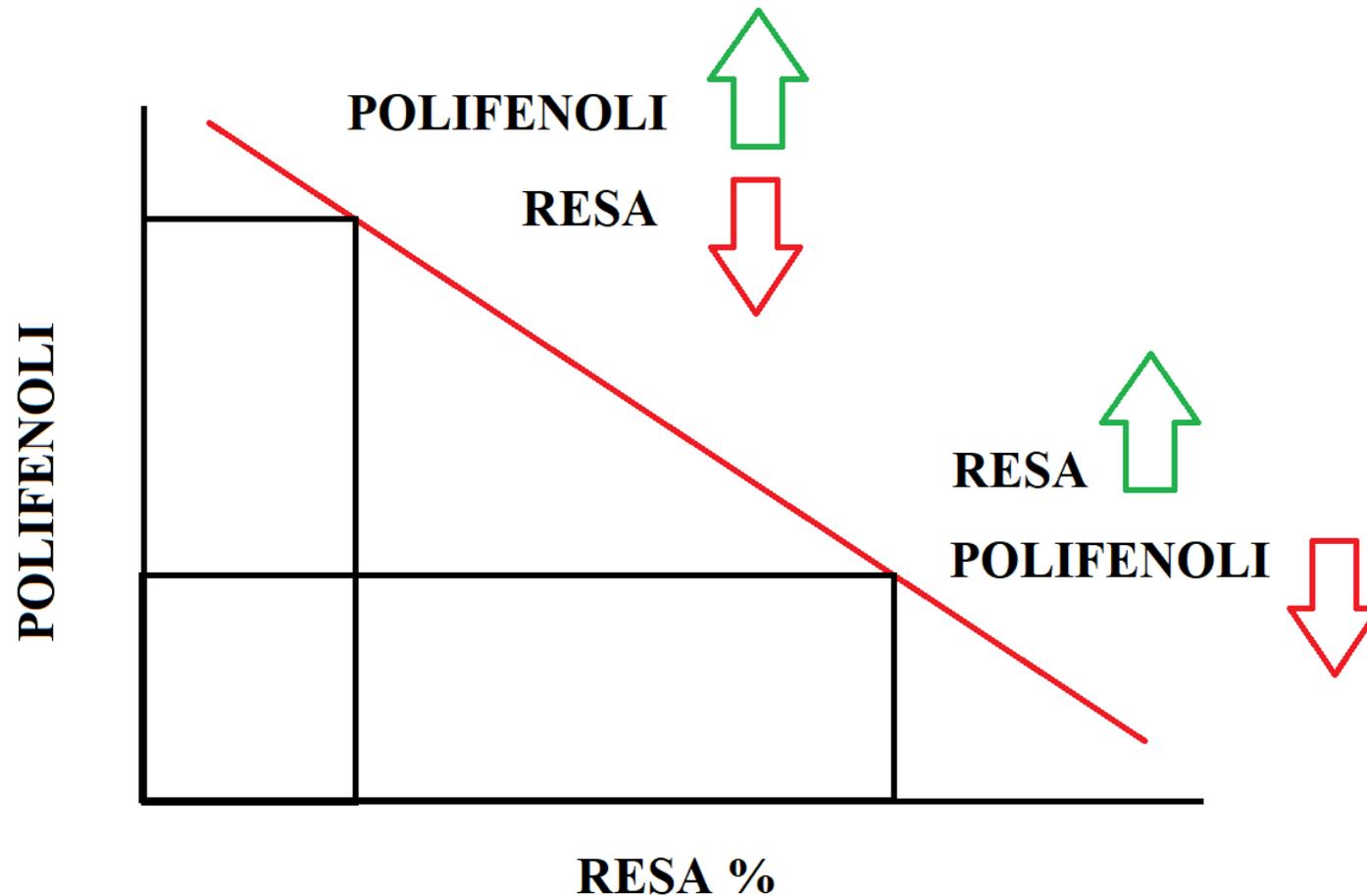
Table 3 Comparison of extraction yields in four olives mills (A,B,C,D) by means of traditional continuous process and ultrasound treatment with SHE, processing four olive cultivars.



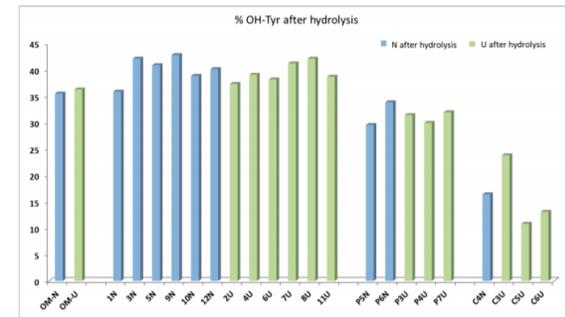
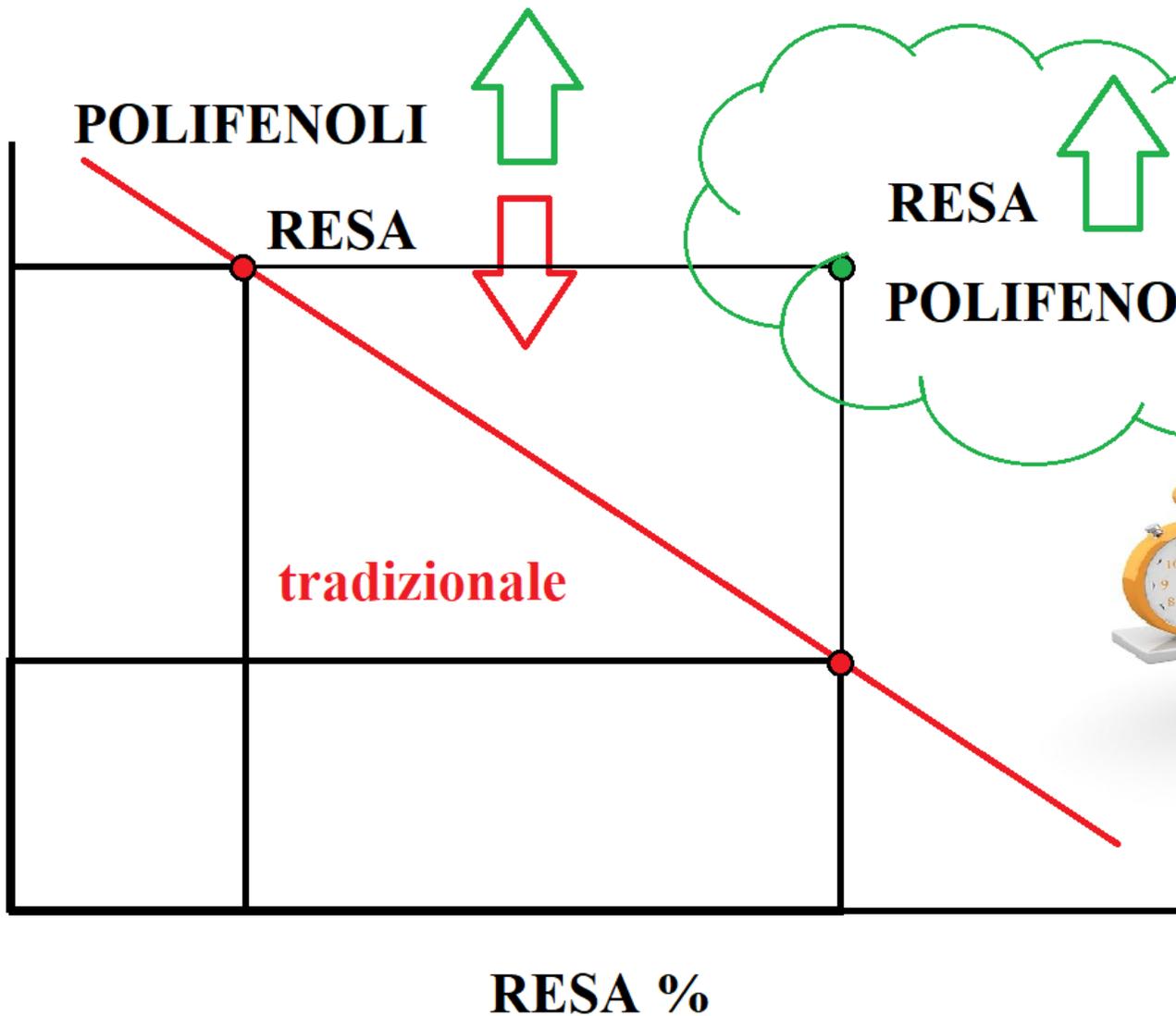
Miller	A	B	B	C	D	D
Cultivar	<u>Peranzana</u>	<u>Micell.</u>	<u>Coratina</u>	<u>Coratina</u>	80% <u>Coratina</u> 20% <u>Ogliarola</u>	<u>Cellina di Nardò</u>
Yield traditional ( <u>kg<sub>extra</sub>/100kg<sub>olive</sub></u> )	12.4%	14.6%	19.7%	12.1%	19.2%	13.2%
Yield US process ( <u>kg<sub>extra</sub>/100kg<sub>olive</sub></u> )	12.8%	15.9%	24.1%	17.6%	20.3%	14.0%
% points in yields increment	+0.5	+1.4	+4.5	+5.4	+1.1	+0.8
Olive processed (tons)	8.0	3.9	2.6	2.6	3.7	3.0
Harvesting	December	November	November	October	January	January



# Cosa succede negli impianti tradizionali?



**POLIFENOLI**





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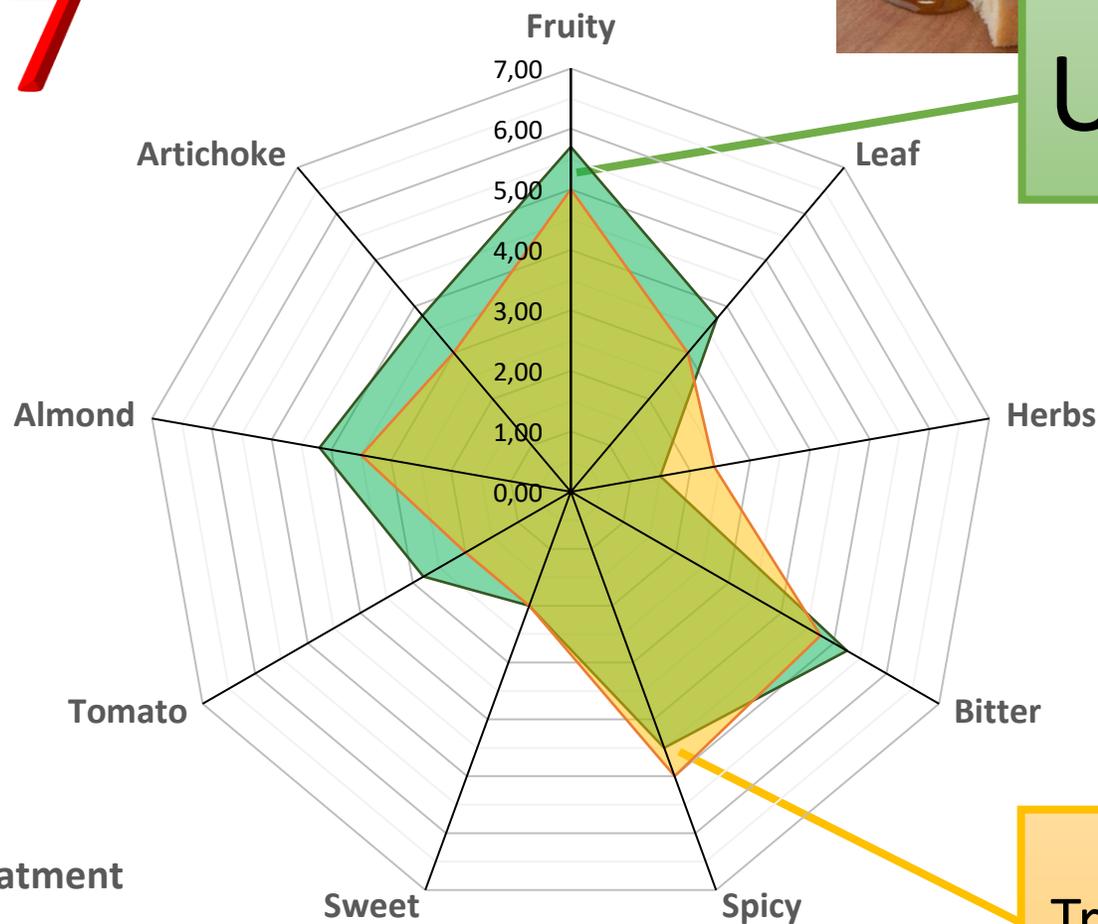


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VOC	1N-12N		P3U-P7U		C3U-C6U		OMN-OMU	
	U	N	U	N	U	N	U	N
LOX C5	0.25 a	0.25 a	0.47 a	0.53 a	0.15 a	0.14 a	1.61 a	1.46 a
LOX C6 aldehydes	7.98 a	8.24 a	11.98 a	12.06 a	5.22 a	5.16 a	34.24 a	34.78 a
LOX C6 esters	2.91 a	2.89 a	0.06 a	0.05 a	0.32 a	0.29 a	0.07 a	0.07 a
LOX C6 alcohols	0.77 a	0.76 a	1.36 a	1.77 a	0.70 a	0.55 a	1.63 a	1.77 a
Total LOX	11.92 a	12.14 a	13.87 a	14.41 a	6.40 a	6.14 a	37.55 a	38.07 a
saturated C7-C10 aldehydes	<0.01 a	<0.01 a	0.29 a	0.30 a	0.01 a	0.01 a	0.15 a	0.18 a
mono-unsaturated C7-C10 aldehydes	0.02 a	0.02 a	<0.01 a	<0.01 a	0.05 a	0.04 a	<0.01 a	<0.01 a
di-unsaturated C7-C10 aldehydes	<0.01 a	<0.01 a	0.24 a	0.26 a	0.03 a	0.02 a	0.12 a	0.13 a

# 2017

Frantoio C  
«Coratina»



UltraS.

Tradizionale





Politecnico  
di Bari



UNIVERSITÀ  
DEGLI STUDI DI BARI  
ALDO MORO



REGIONE PUGLIA



Progetti - INNONETWORK



Frantoio Mimì – Frantonio Mossa

2019



Frantoio Mimi

2019



REGIONE PUGLIA



Progetti - INNONETWORK





Politecnico  
di Bari

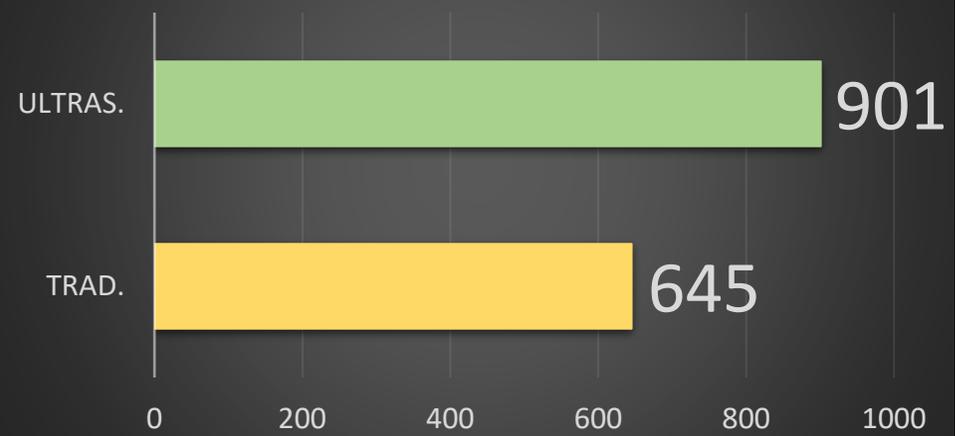


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ALDO MORO

2019

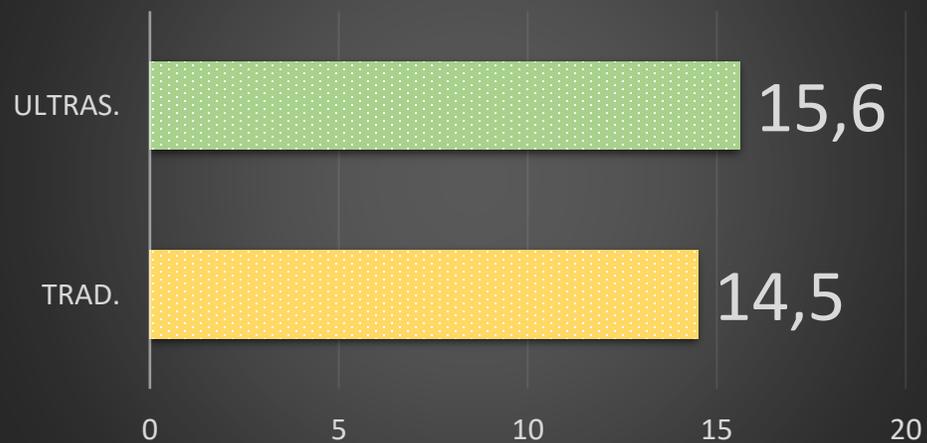


### Biofenoli (mg/kg)



Frantoio Mimì – Frantonio Mossa

### Resa (kgevo/100kgolive)



# OLIVE-SOUND



*Ultrasound reactor*

*The solution for a continuous olive oil extraction process*

The **OLIVE-SOUND** concept was triggered by the need of the olive oil producers to face the main challenge in the current **VOO** extraction process; convert the long and costly batch step of malaxation of the olive paste into a continuous process.

## Participant organization name

**Gruppo Peralisi - MAIP S.p.A. (Italy)**

**CEDRAT TECHNOLOGIES (France)**

**University of Bari (Italy)**

**AIDISA (Asociación para la Investigación, Desarrollo e Innovación del Sector Agroalimentari) (Spain)**

**Almazara del Ebro, S. Coop (Spain)**

# Objectives

- **Reduction of process time by 70%:** improved working capacity of the VOO mill and transformation of VOO extraction into a real continuous process.
- **Energy conservation:** 65% less energy consumption through the reduction both of process time and water use.
- **Cost-effectiveness:** the expected purchase price is 30% less than the price of a traditional malaxation system.
- **Improved VOO quality:** higher recovery of phenols and inactivation of enzymes that oxidize them.
- **Compliance with EU regulations:** a totally physical/mechanical process.
- **Modulation of the process:** hot and cold conditioning of olive paste with the aim to modulate the beneficial and sensory characteristics of the products.

# Now...Olive sound.

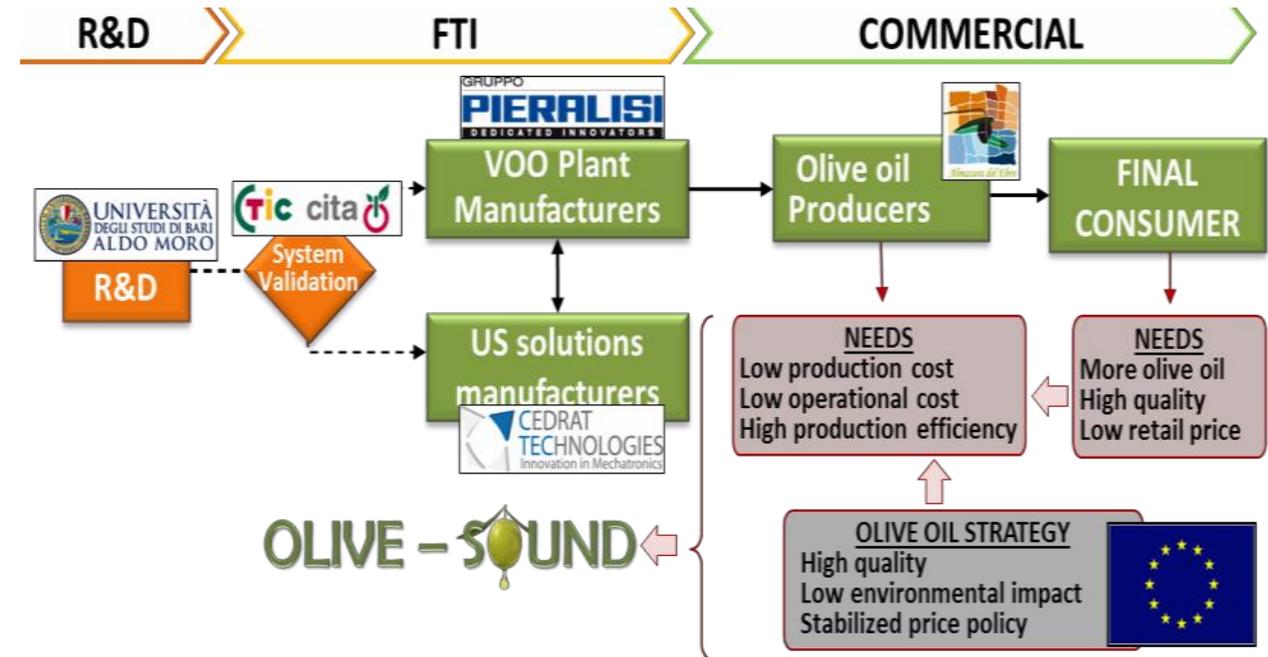
## Ambition

To introduce in the market in **24 months** a novel ultrasound reactor for the treatment of olive paste which will **reduce process time by 70%**.

-To obtain an **increase in yield by about 5 – 6 %**.

-To enhance the release of minor compounds promoted by US waves, improving the quality of the extracted oil that will be superior in terms of both sensorial and nutritional properties.

-To reach an high level of sustainability of the whole extraction process due to reduced energy consumption



*The Planned design for scale-up of the new Prototype reported in the project is under IP agreement among the partnership .....*

# An innovation that looks to the 2030 Agenda for Sustainable Development

**Ultrasound technology represents a multifaceted strategy able to interpret the concept of green food processing:**

- **has a significant effect on the rate of various processes in the food industry (in this case replaces the long time of malaxation in few minutes)**
- **assures high reproducibility,**
- **reduces the processing cost,**
- **simplifies manipulation and work-up,**
- **saves energy consumption**
- **has beneficial effects also on the amount of secondary metabolites (such as polyphenol and tocopherols characterized by healthy effects approved by the European Food Safety Authority) extracted from the olive paste.**

# In Conclusion

**Over a decade (2011-2019), an idea has become an innovation thanks to:**

- many skills
- transdisciplinary approach
- project management skills able to attract public and private funds, crucial to develop an innovation

**But, above all the ability to be a team and the enhancement of different skills**

# UNIBA and Poliba team



## Team work

Lentini Giovanni  
Cavalluzzi Marilena  
Milani Gualtiero  
Curci Francesca  
Perugini Luisa  
Palmieri Tiziana  
Thesis Students



**Riccardo Amirante and Maria Lisa Clodoveo**

**.....The true soul of this innovative idea**



Carlo Franchini

