PROTOTIPO DI FRANTOIO, L'IMPIANTO DI BUCINE-. PARTE 2

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Caso studio 1: effetti qualitativi del separatore centrifuge verticale

«Pulisce» l'olio da acqua e solidi sospesi

Veiled oil samples	Degree of turbidity [NTU]	Water content [%w/w]	Solid particle content [%w/w]	Water/ solids ratio	A_w
VO#1	1677 ± 6^{a}	0.25 ± 0.01^{b}	0.25 ± 0.01^{b}	1.00	0.72 ± 0.01^{c}
VO#2	1428 ± 13^{d}	0.37 ± 0.01^{a}	0.14 ± 0.07^{d}	2.64	0.73 ± 0.01^{c}
VO#3	845 ± 13^{e}	0.22 ± 0.01^{c}	0.16 ± 0.01^{cd}	1.38	0.62 ± 0.01^{d}
VO#4	836 ± 10^{e}	0.21 ± 0.01^{cd}	0.33 ± 0.02^{a}	0.64	0.65 ± 0.01^{e}
VO#5	1475 ± 12^{c}	0.16 ± 0.01^{e}	0.27 ± 0.08^{b}	0.59	0.78 ± 0.01^{b}
VO#6	1519 ± 8^{b}	0.20 ± 0.01^{d}	0.21 ± 0.04^{bc}	0.95	0.82 ± 0.01^{a}

Olio al decanter

Oli velati

	A	C	C2	C3	CP	K	K2	M	N	O
Grado di torbidità (NTU)	130	1361	139	412	386	245	294	95	1773	112
Microorganismi (log UFC/g)	4.30	5.37	4.72	4.18	4.71	4.00	4.59	2.39	5.02	4.17
Attività dell'acqua	0.68	0.80	0.64	0.78	0.76	0.70	0.74	0.63	0.80	0.86
Contenuto d'acqua (%w/w)	0.20	0.42	0.24	0.33	0.26	0.18	0.18	0.11	0.36	0.22
Contenuto di solidi insolubili (%w/w)	0.04	0.19	0.17	0.18	0.1	0.32	0.41	0.25	0.31	0.54

Olio al separatore

- Sono stati valutati gli effetti dell'uso di questa centrifuga sull'olio di oliva

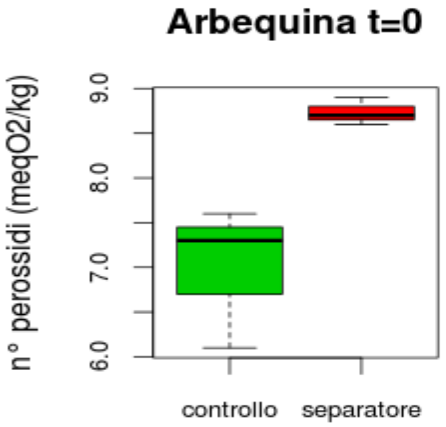
- L'olio è stato prodotto normalmente, una parte è stata imbottigliata, mentre l'altra ha subito un secondo trattamento al separatore

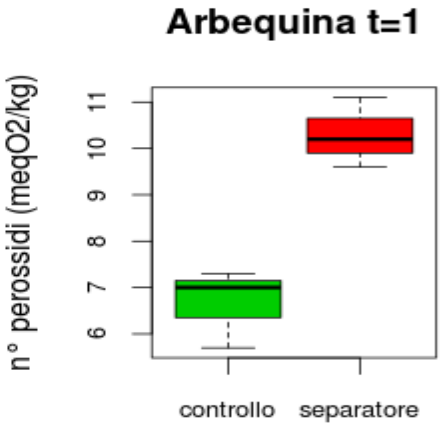
- Sono state usate 2 cv (Arbequina e Coratina) ed effettuate 3 repliche di ciascun trattamento. Subito imbottigliati. Analisi dopo 3 e dopo 6 mesi (illuminazione neon 10 h/d)

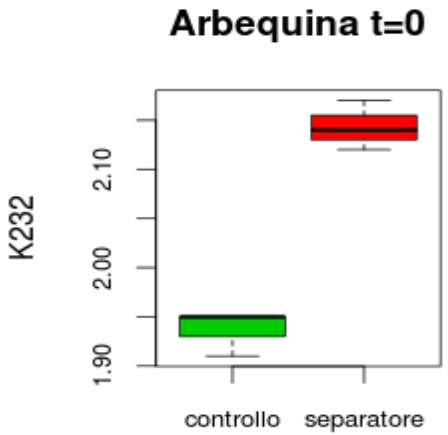
Effetti qualitativi del separatore centrifuge verticale

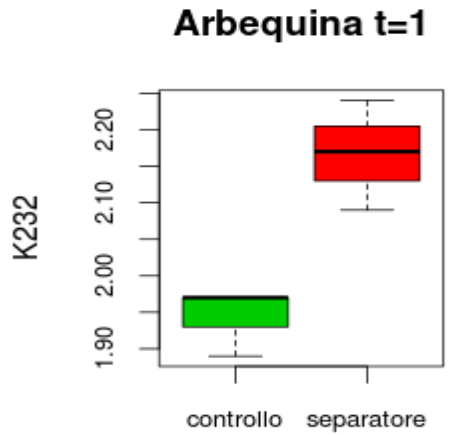
Aggiunta ossigeno disciolto (circa 5 ppm)
Aumento temperatura (circa 3.5 °C)
Dilavamento composti idrosolubili (dovuto all'acqua di processo)

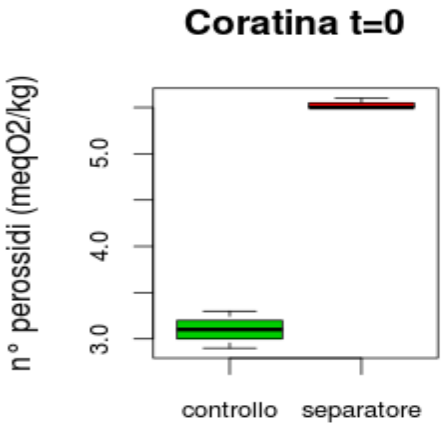
Ossidazioni separatore centrifugo verticale

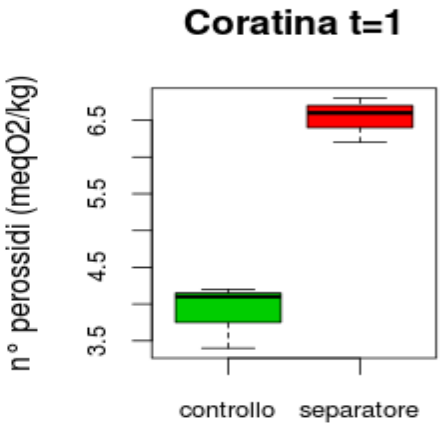


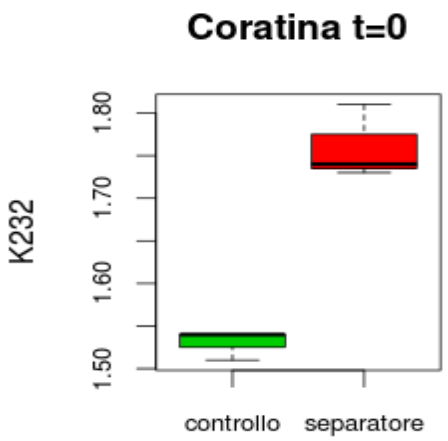


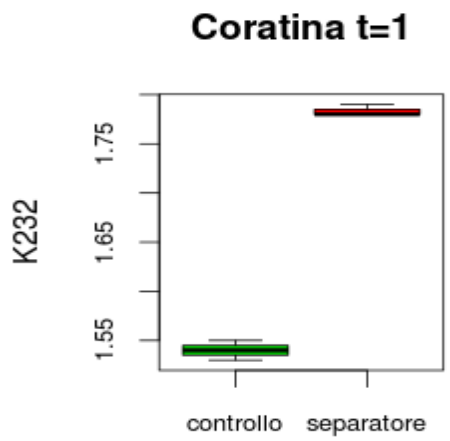




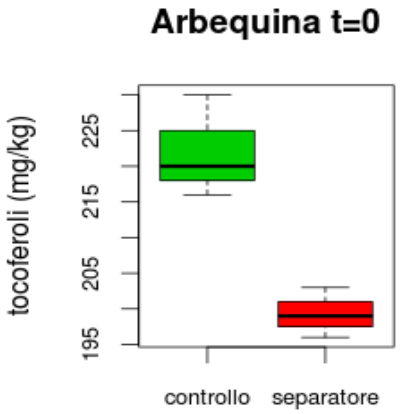


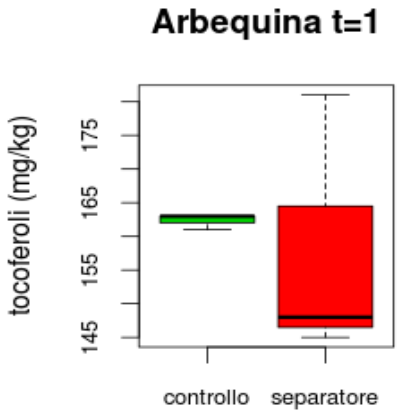


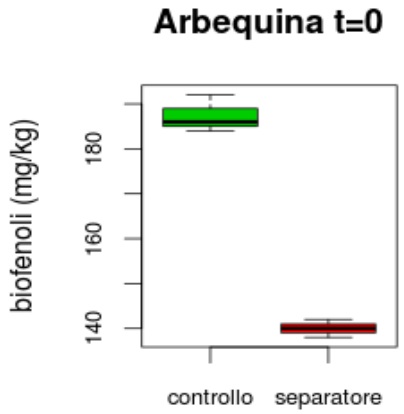


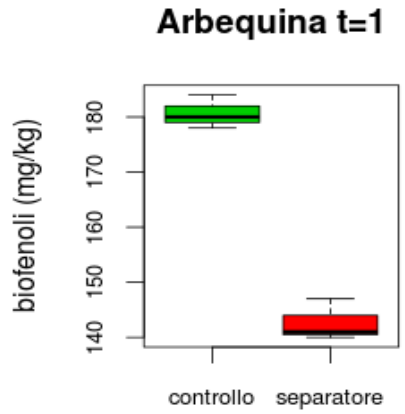


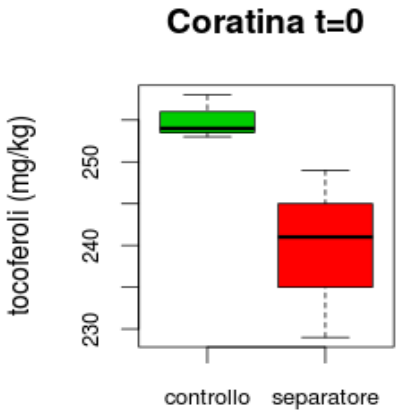
Antiossidanti separatore centrifugo verticale

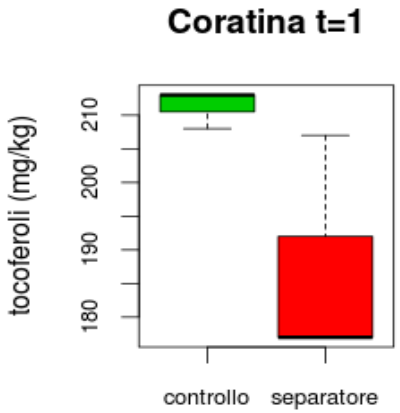


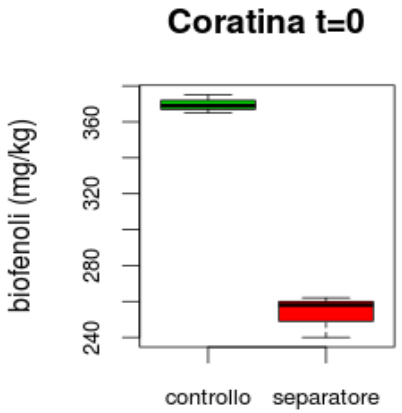


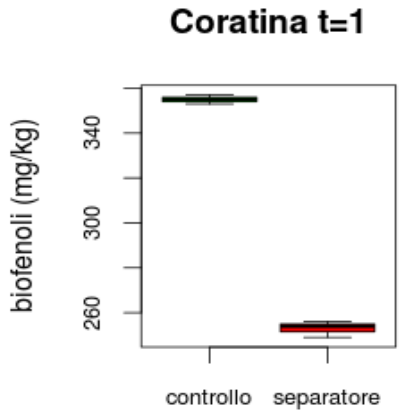




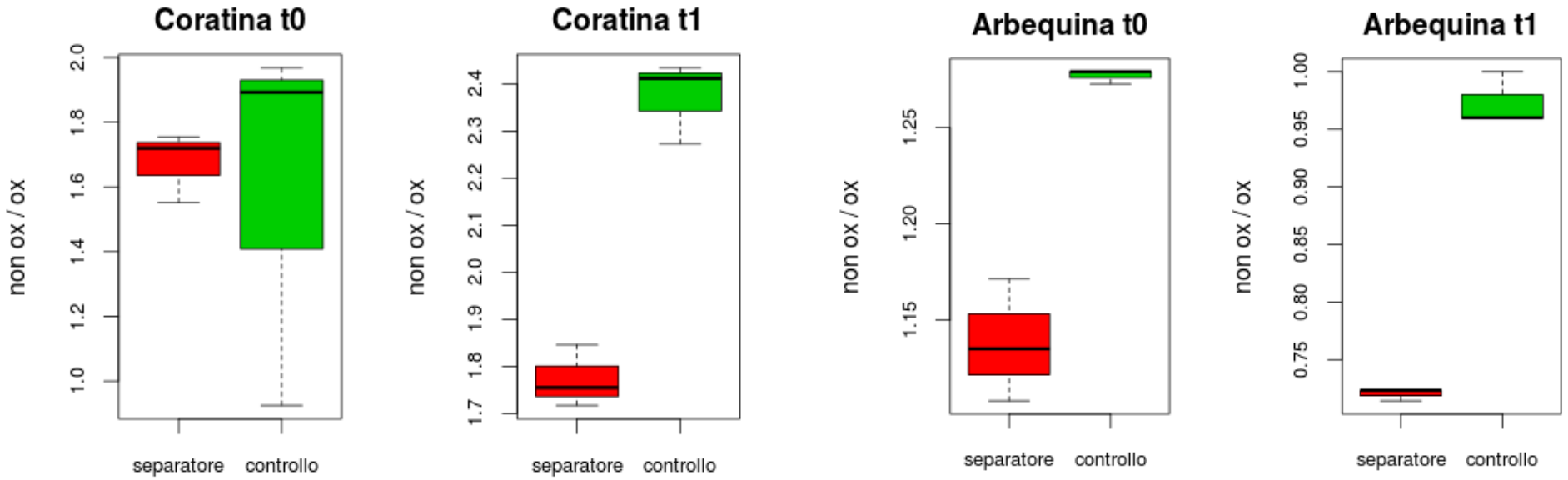








separatore centrifugo verticale: ossidazione secoiridoidi



Oltre il separatore…

- **Filtrazione in linea**

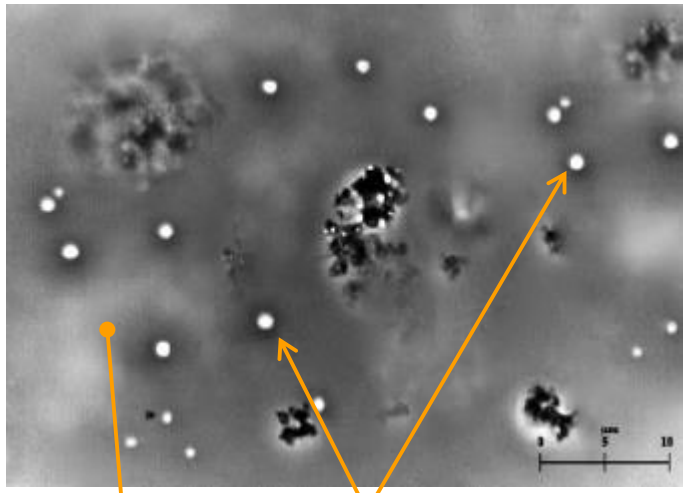
L'olio in uscita dal separatore deve nella maggior parte dei casi essere filtrato per la sua stabilizzazione.

Alcuni frantoi di piccole/medie dimensioni si stanno dotando di impianti privi del separatore e filtrano l'olio in linea (o quasi) con il decanter.

Perché filtrare?

Gli oli appena prodotti hanno un aspetto tipicamente velato, determinato dalla presenza in piccole quantità di una fase dispersa (acqua) e di una fase solida (frammenti della drupa) in sospensione in stato semicolloidale.

Koidis et al., Eur. J. Lipid Sci. Technol. 2008, 110, 164–171



↘ proteine

↘ polifenoli

↘ fosfolipidi

↘ cere

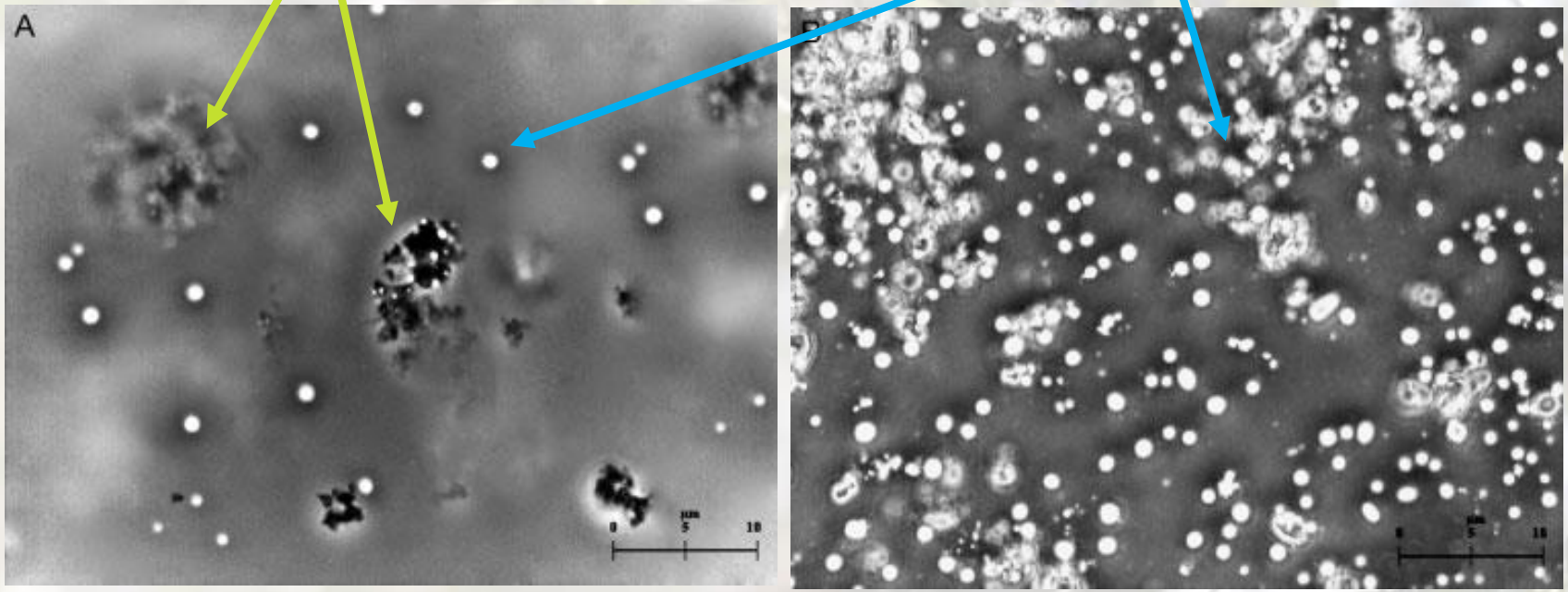
↘ zuccheri

Torbidità

Emulsione della fase acquosa in una fase continua apolare

Solidi sospesi

Acqua

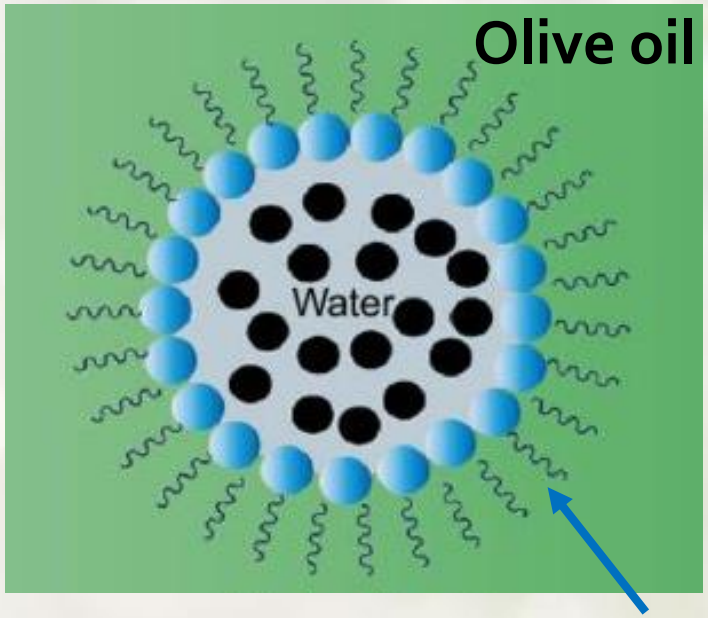


From Koidis et al. (2008)

Introduction

Acqua

Micro gocce 1-5 µm si trovano in forma di associazioni colloidali stabilizzate da emulsionanti dell'oliva (fosfolipidi e proteine)



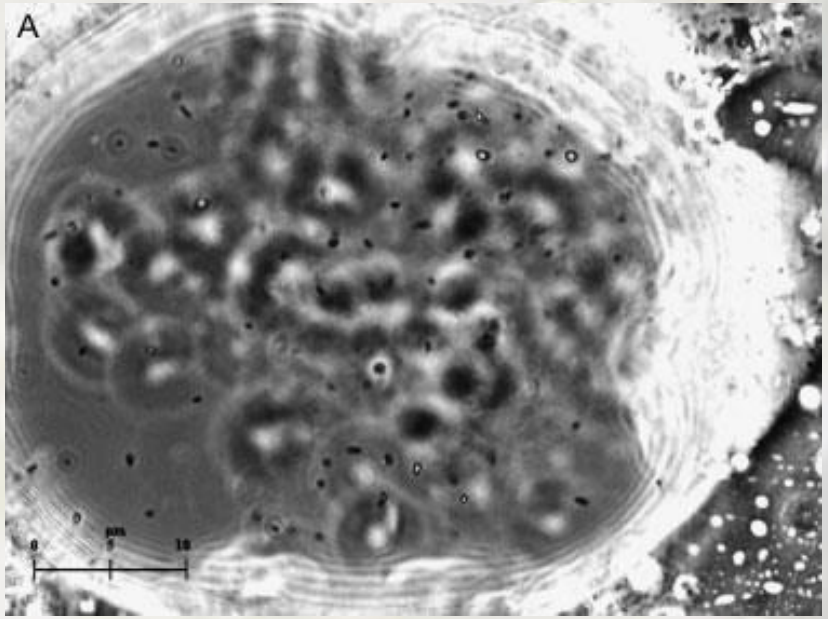
- **Permette la vita dei microrganismi**
- **Contiene composti fenolici**

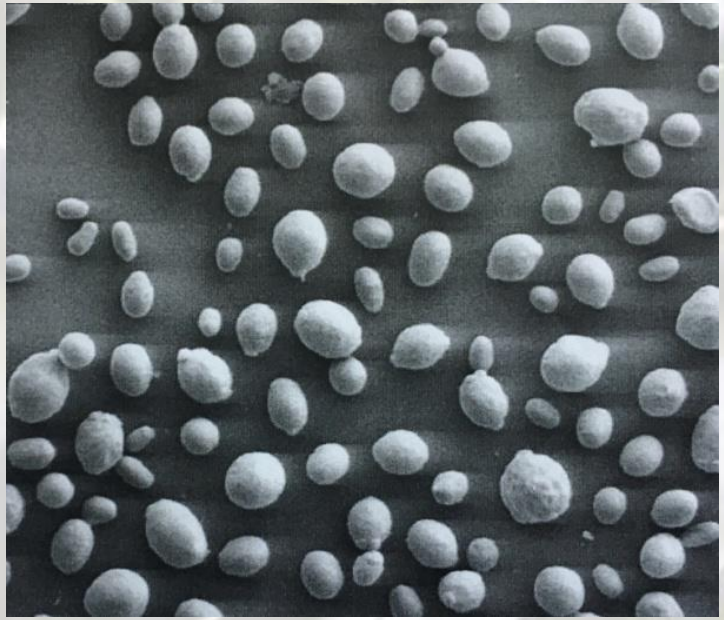
Introduction

Microorganismi

Attività enzimatica Idrolisi dei triacil gliceroli
Cambiamento delle proprietà sensoriali

Off flavours →riscaldo, morchia, avvinato, muffa



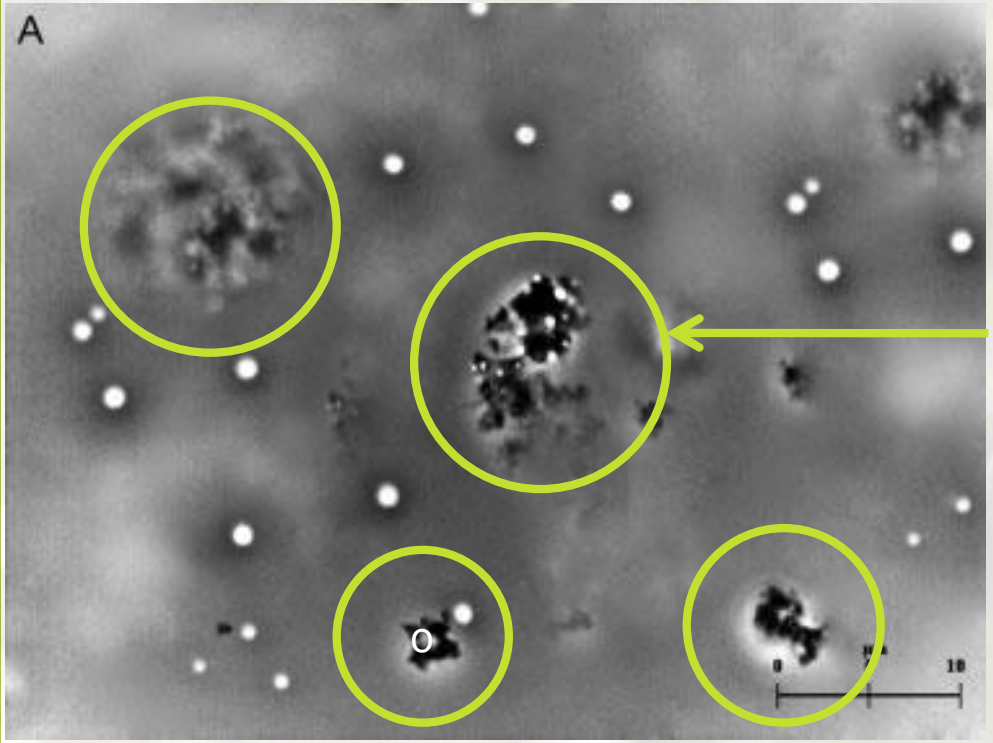


From Ciafardini and Zullo (2018)

Introduction

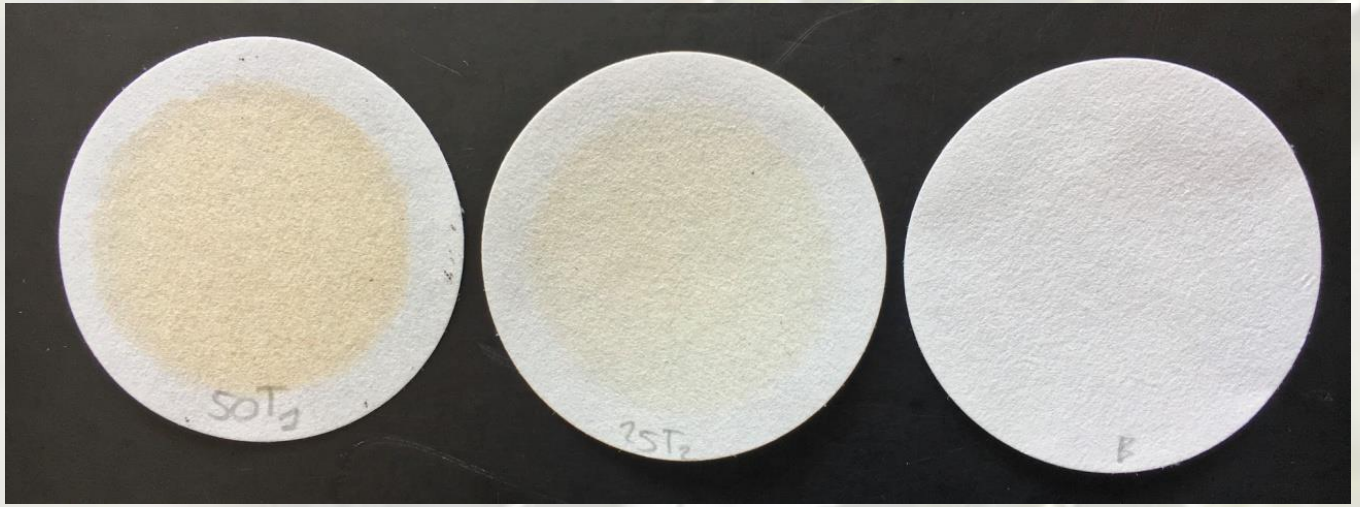
Solidi sospesi

Deriving from the olive fruit and transferred to the oil during the process. Mainly carbohydrates, phospholipids, proteins, polar phenols



5-60 µm

From Koidis et al. (2008)



Objectives

1.

Characterize the **water-solids dispersion suspension** system responsible for the olive oil cloudy appearance

2.

Measure the qualitative effects of the **turbidity** during the **storage** in oil treated with **different stabilization techniques**





Materials and Methods

1. Characterization of turbidity

Code	Turbidity type	Treatment	Description
T	**Turbid**	No	Bottling of freshly extracted olive oil
L	**Limpid**	Filtration	Portable filter-press (5 cellulose-sheets)
A	**Water**	Filtration w glass wool	Laboratory apparatus
S	**Solids**	Freeze drying	Water sublimation by freeze drying

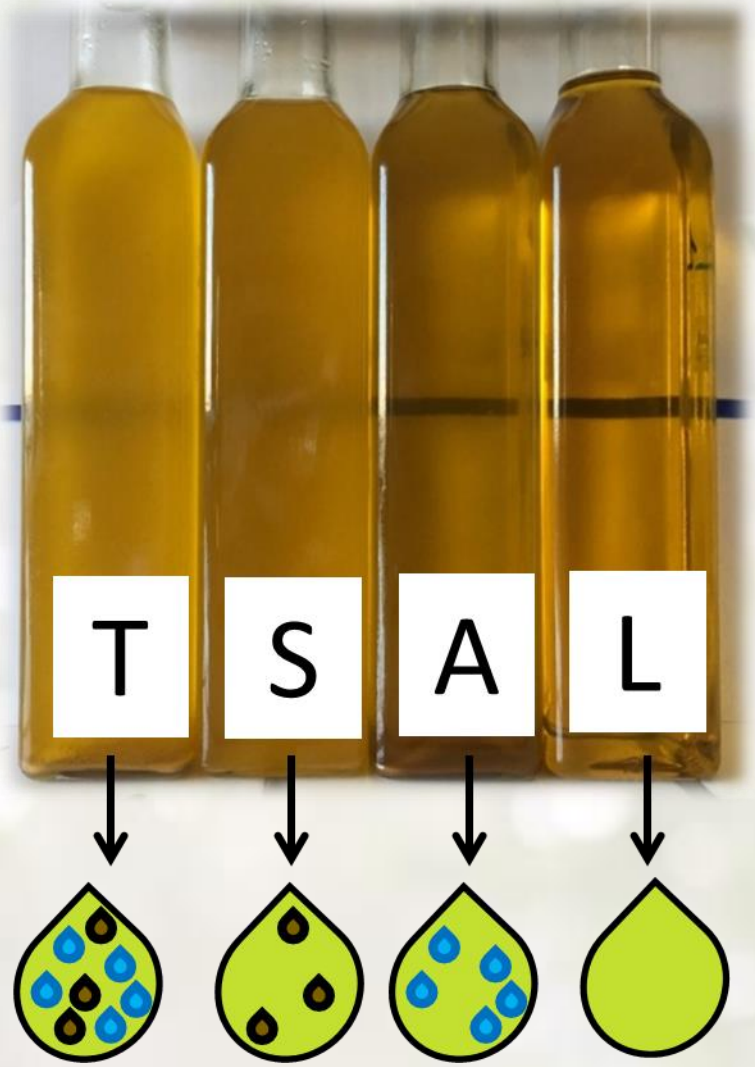
Materials and methods

Characterization of turbidity Laser Scanning Confocal Microscopy

- Leica Microsystems GmbH
- 100X oil immersion objective
- 488nm laser used to acquire the fluorescent emission
- 1 mg Rhodamine 110 in 5 g of olive oil sample (green fluorescence)

Results and Discussion

1. Characterization of turbidity

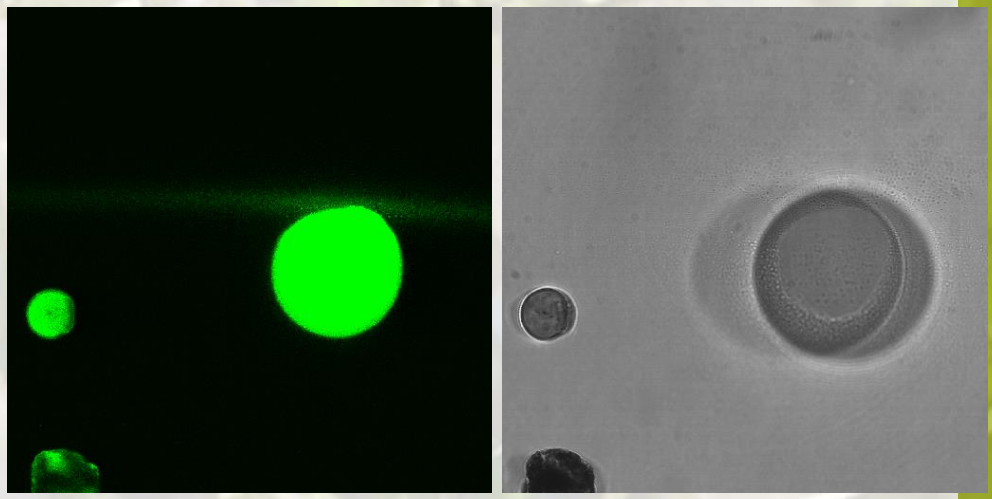


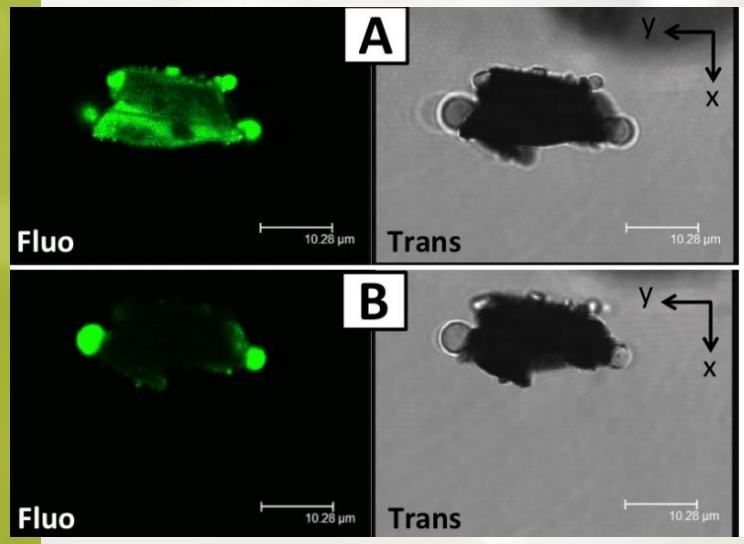
Oil samples at the different separation treatments	Degree of turbidity (NTU)	Water content (%w/w)	Solid particles content (%w/w)	Aw	Microbial cell count (log UFC/g)	Total phenolic compounds
p	***	***	***	***	***	***
T	1296 a	0.24 a	0.23 a	0.68 a	3.8 a	708 ab
L	15 c	0.05 c	0.00 b	0.43 c	n.d. b	559 c
S	181 b	0.03 d	0.20 a	0.37 c	1.3 b	678 b
A	59 c	0.11 b	0.00 b	0.53 b	2.4 b	736 a

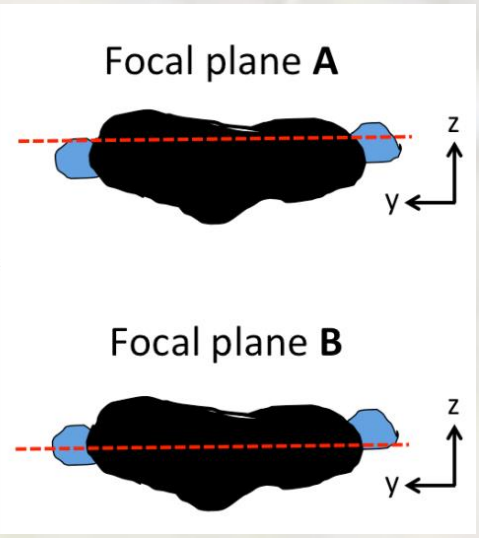
Results and Discussion

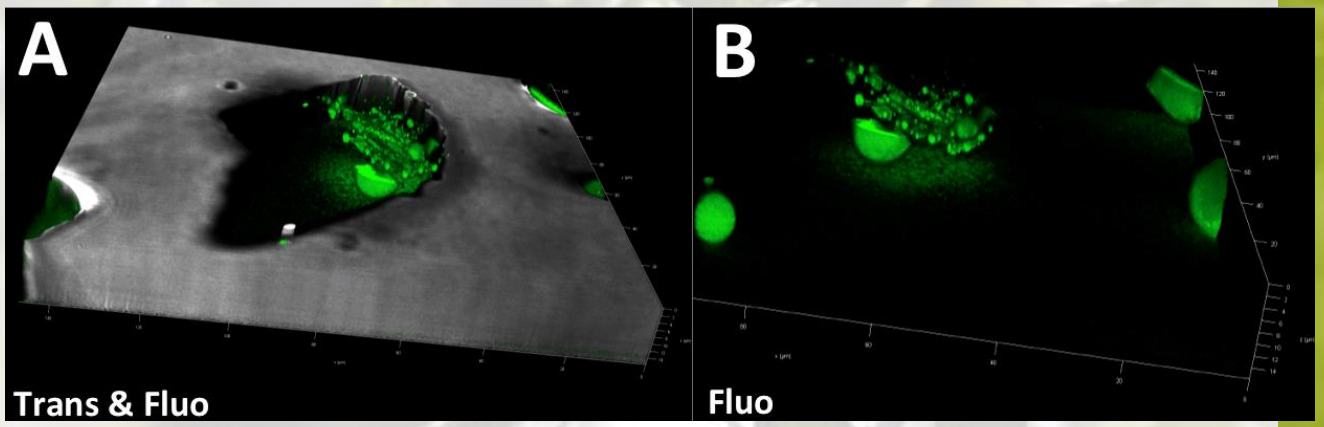
1. Characterization of turbidity

- Water was present in veiled olive oil as:
  - Isolated drops
- Smaller droplets adsorbed on the solid particles' surface
  - Film around the solids









Aspetti teorici della filtrazione

Due tipi di filtrazione
- di superficie (azione di setacciamento meccanico)
- di profondità (ritenzione per fenomeni chimico-fisici)

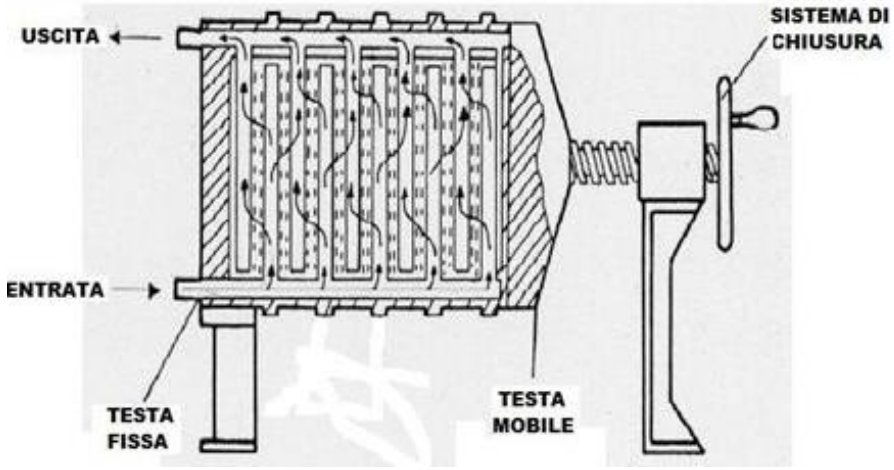
velocità di filtrazione → $\frac{1}{A}\frac{dV}{dt} = \frac{\Delta P}{\mu(\alpha w V/A + r)}$ ← gradiente di pressione

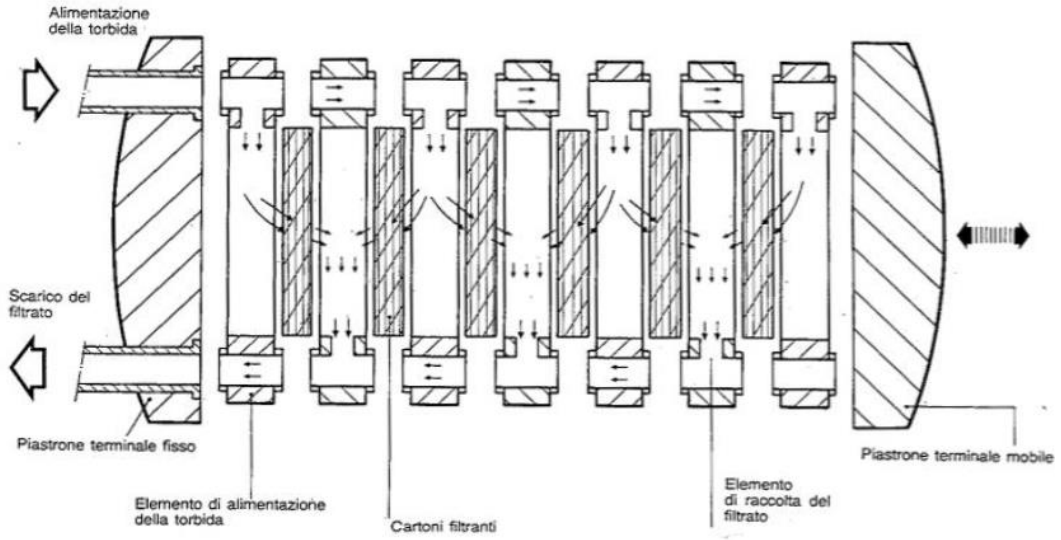
- μ: viscosità
- α: resistenza del deposito
- w: carico di solidi
- r: resistenza del mezzo filtrante

Tipologie di filtro

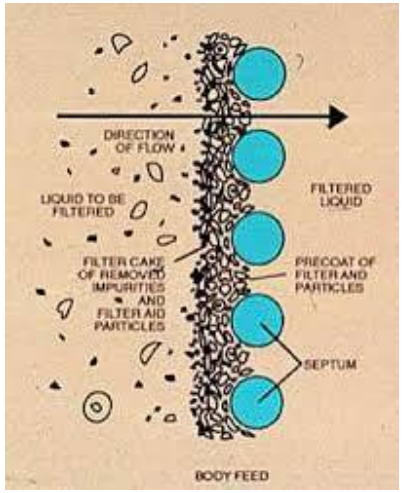
FILTRI A COTONE

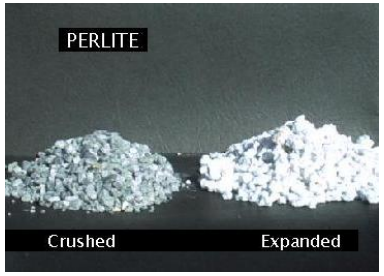
FILTRI PRESSA A CARTONI



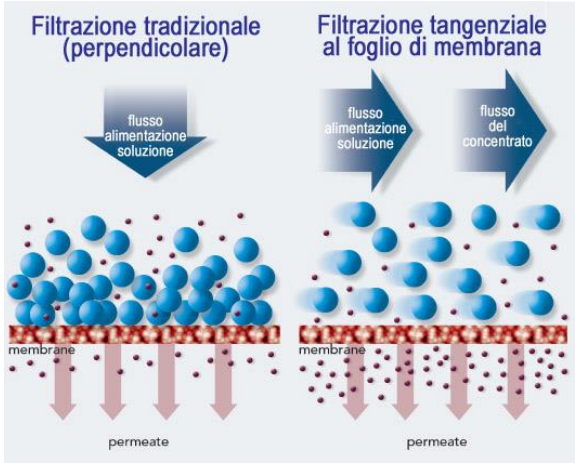


FILTRI AD ALLUVIONAGGIO CON COADIUVANTI





FILTRI TANGENZIALI



Caso studio 2: effetti della filtrazione e aggiunta di un prefiltro

Un unico batch di olio è stato suddiviso in 2 sottobatch. Uno è stato filtrato con un filtro a cartone e l'altro lasciato velato.

Tre repliche.

Olio conservato in bottiglie da 0.5 L fino al luglio successivo.

Effetti qualitativi della filtrazione

Table 1. Mean quality indices, chlorophylls, total tocopherols and total phenolic compounds for all cloudy and filtered samples

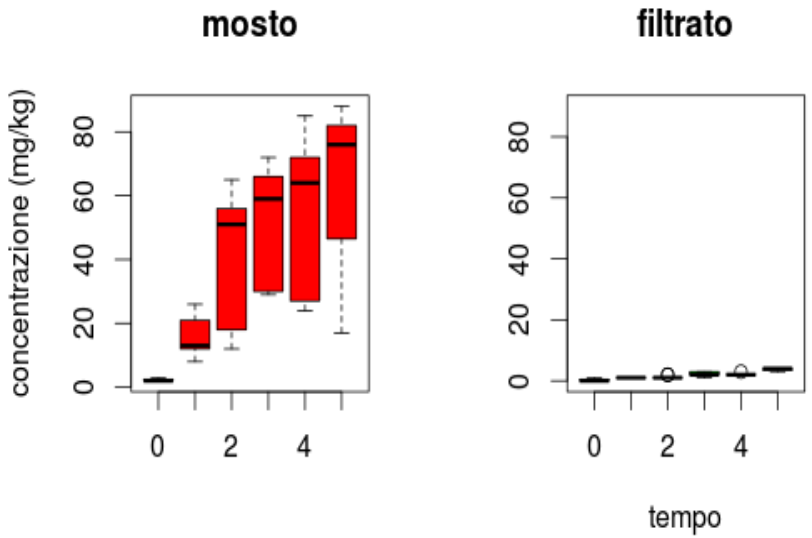
	Sample type	Time 0	15-Jan-2014	20-Feb-2014	02-Apr-2014	20-May-2014	5-Jul-2014
Free acidity (%)	Cloudy oil	0.26 (0.02) a	0.28 (0.02) a	0.24 (0.02) a	0.32 (0.02) a	0.32 (0.01) b	0.33 (0.04) a
	Filtered oil	0.22 (0.02) a	0.19 (0.01) a	0.15 (0.01) a	0.17 (0.00) a	0.19 (0.01) a	0.20 (0.00) a
Peroxide value	Cloudy oil	3.9 (0.3) a	4.1 (0.2) a	4.4 (0.3) a	4.4 (0.3) a	3.7 (0.2) a	3.6 (0.0) a
($meqo_2/kg_{olio}$)	Filtered oil	4.5 (0.5) a	6.0 (0.1) b	6.8 (0.4) b	6.3 (0.3) b	5.6 (0.2) b	5.4 (0.4) b
K_{232}	Cloudy oil	1.71 (0.09) a	1.63 (0.02) a	1.62 (0.02) a	1.59 (0.02) a	1.62 (0.02) a	1.57 (0.02) a
	Filtered oil	1.77 (0.08) a	1.69 (0.02) b	1.70 (0.02) b	1.67 (0.04) a	1.73 (0.02) b	1.64 (0.05) a
K_{270}	Cloudy oil	0.14 (0.017) a	0.13 (0.01) a	0.13 (0.00) a	0.13 (0.00) a	0.14 (0.00) a	0.16 (0.00) a
	Filtered oil	0.15 (0.011) a	0.13 (0.00) a	0.15 (0.00) b	0.15 (0.00) a	0.16 (0.00) a	0.16 (0.01) a
ΔK	Cloudy oil	−0.005 (0.001) a	−0.003 (0.000) b	0.000 (0.000) b	0.001 (0.000)	0.001 (0.000) a	0.002 (0.000) a
	Filtered oil	−0.005 (0.001) a	−0.004 (0.000) a	−0.003 (0.000) a	0.000 (0.000)	0.001 (0.003) a	0.001 (0.000) a
Tocopherols	Cloudy oil	197 (7) a	175 (4) a	166 (2) a	160 (4) a	170 (3) a	147 (6) a
(mg/kg)	Filtered oil	196 (8) a	187 (4) a	173 (2) a	169 (1) a	171 (1) a	150 (3) a
Total phenolic	Cloudy oil	337 (26) a	332 (8) a	332 (26) a	366 (18) a	379 (17) b	370 (58) a
compounds (mg/kg)	Filtered oil	313 (27) a	352 (17) a	343 (20) a	371 (19) a	396 (19) a	398 (30) a
Chlorophylls	Cloudy oil	19 (2) a	18 (1) a	16 (1) a	13 (1) a	4 (1) a	0 (0) a
(mg/kg)	Filtered oil	18 (2) a	13 (1) b	7 (1) b	4 (0) b	2 (1) a	0 (0) a

Standard error is given in brackets. The letters (a, b) indicate significant differences based on the paired t-test ($P < 0.05$). Comparisons are valid at the time of analysis (Time 0, January, February, etc.).

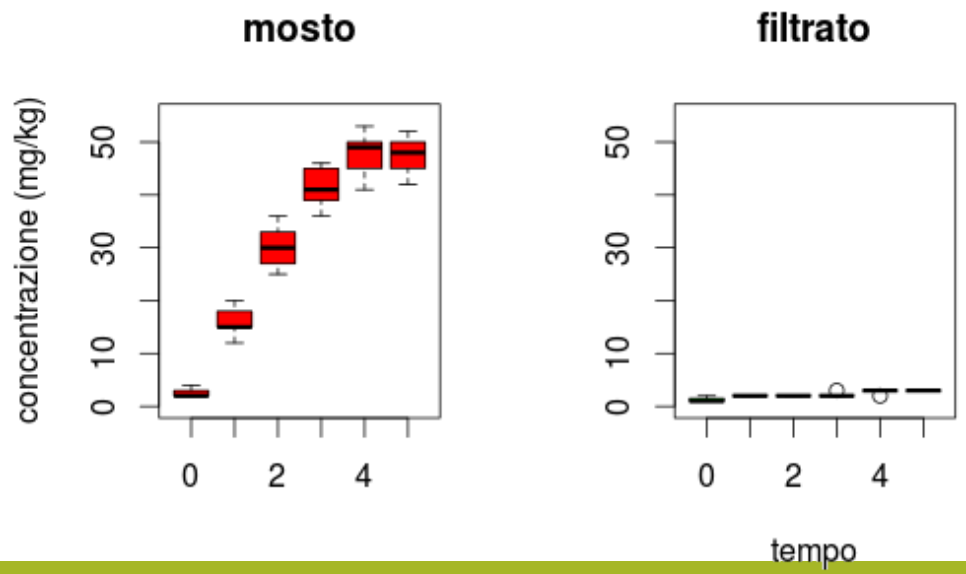
Effetti qualitativi della filtrazione

Protezione della componente fenolica dall'idrolisi

Idrossitirosolo



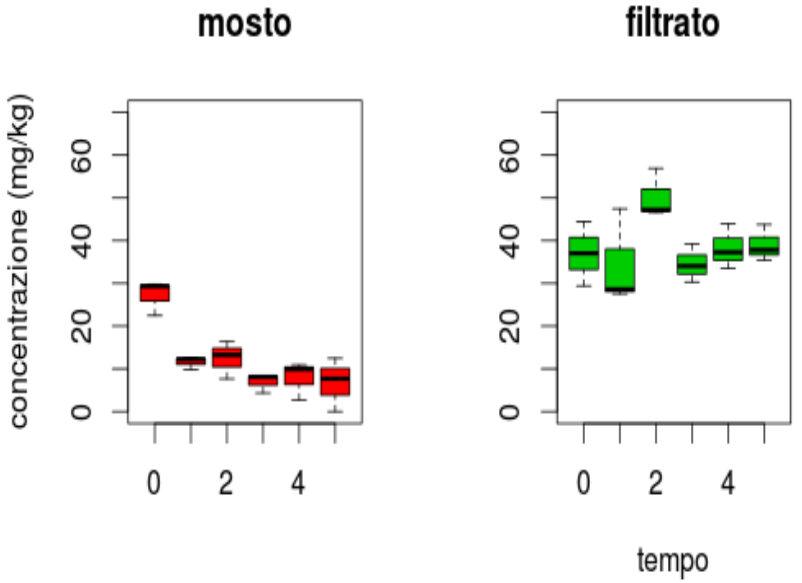
Tirosolo



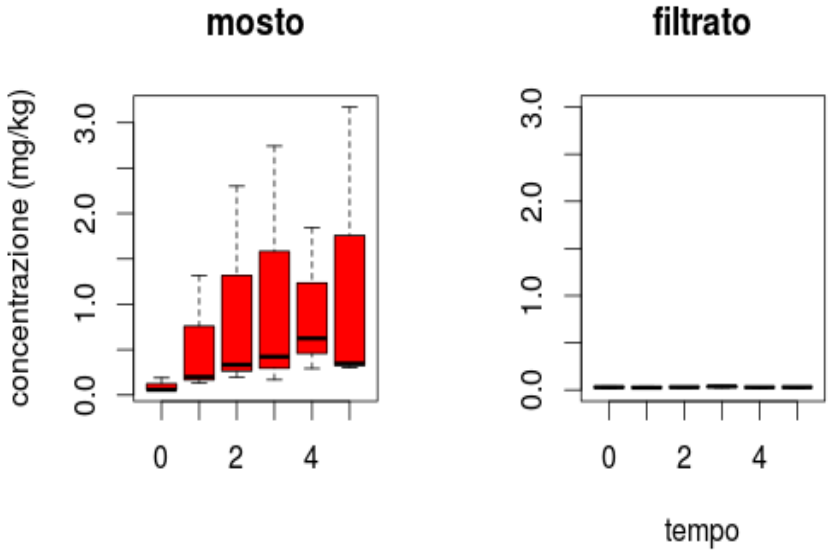
Effetti qualitativi della filtrazione

Profilo aromatico

E – 2 – Esenale: «fruttato»



Etil acetato : «avvinato»



Effetti qualitativi della filtrazione Riscaldo

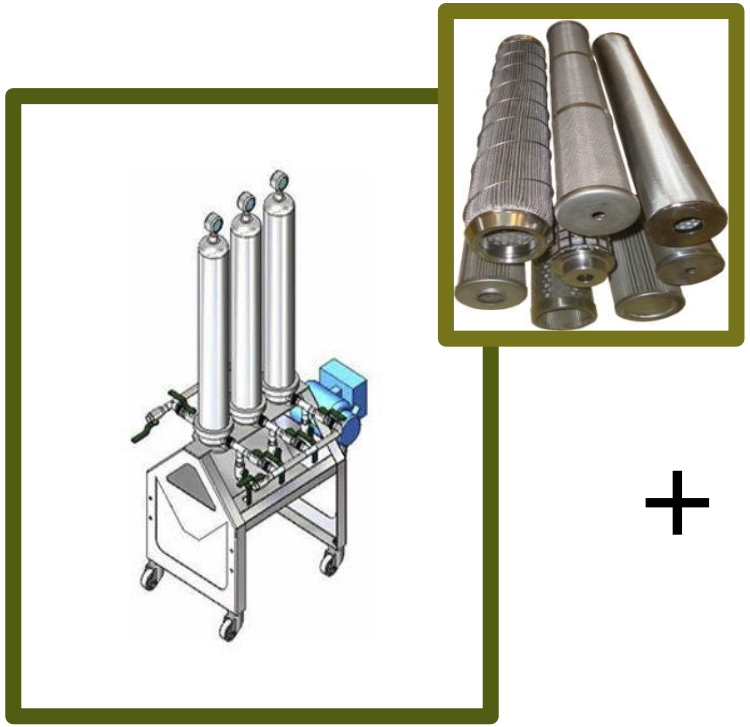
Data assaggio	Velato	Filtrato
Gennaio	1.8 (0.3)	0.0 (0.0)
Febbraio	2.0 (0.0)	0.0 (0.0)
Aprile	2.3 (0.6)	0.0 (0.0)
Maggio	2.7 (0.3)	0.0 (0.0)
Luglio	2.6 (1.2)	0.0 (0.0)

Problematiche filtrazione con filtro a cartoni

- **«Efficienza operativa»: quantità di olio trattato per ciclo, capacità operativa ed impiego di manodopera.**
- **Perdite di olio che rimane "intrappolato" 5% dell'olio filtrato**
- **Servono circa 14 setti 40 cm x 40 cm per filtrare 100 kg di olio mosto .**
- **Costi di acquisto di circa 0,9 euro a cartone, costi di smaltimento circa 0,60 euro a cartone .**

Impatto sull'ambiente, uso di cartoni usa e getta

Introduzione di uno step di pre-filtrazione



filtro a cartucce in acciaio
40, 20 e 5 µm

+

filtro pressa a cartoni

Condizioni test di confronto (5)

Configurazione filtro "con pre-filtro"

- 3 cartucce in acciaio (40 µm – 20 µm – 5 µm)
- 11 setti filtranti 40 cm x 40 cm (V8 – Cordenons)
- Superficie filtrante totale: 2.231 m2

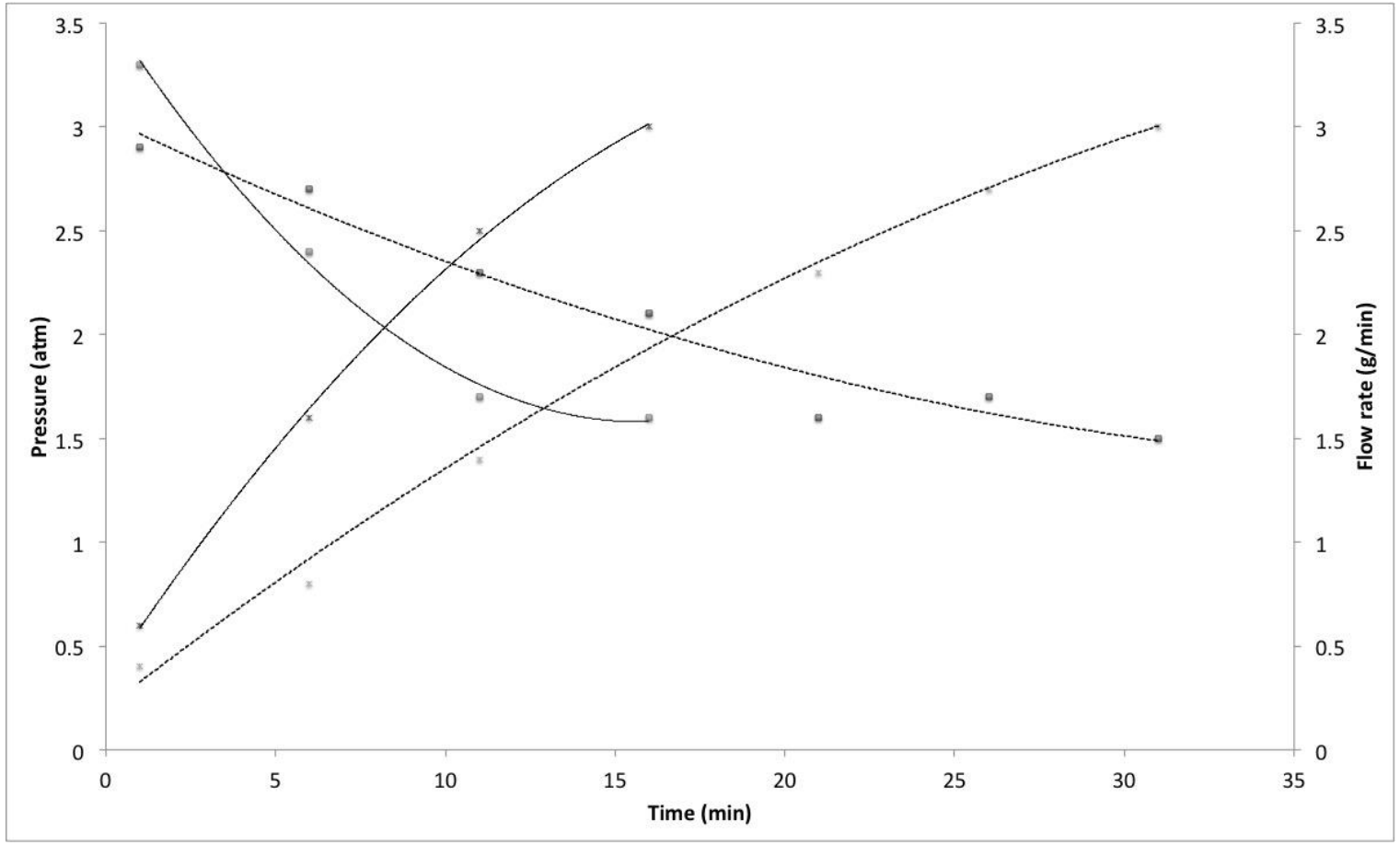
Configurazione filtro-pressa

- 11 setti filtranti 40 cm x 40 cm (V8 – Cordenons)
- Superficie filtrante totale: 1.76 m2

Caratteristiche cartucce: acciaio, altezza 0.76 m; diametro 0.066 m
Caratteristiche cartoni: cellulosa + diatomeacee; peso a metro quadrato 1050 g/m2; 3.40 mm spessore; 12 µm porosità nominale; 160 l/min portata di acqua.

Aggiunta del pre-filtro

DAL DECANTER



Aggiunta del pre-filtro

DAL DECANTER

OLIO FILTRATO
Pre-filtro: 144 kg
Filtro-pressa: 78.4 kg

Olio filtrato: + 83.7%
(aumento superficie: + 26.8%)

DURATA FILTRAZIONE
Pre-filtro: 78.48 min
Filtro-pressa: 35.18 min

Durata filtrazione: + 123.1 %

Aggiunta del pre-filtro

	Pre-filtro	Filtro-pressa
Acidità (%)	0.17	0.16
N° perossidi (meqO2/kg)	4.10	4.00
K232	1.76	1.57
K270	0.12	0.12
ΔK	-0.005	-0.004
Tocoferoli (mg/kg)	204	207
Biofenoli (mg/kg)	360	359

	Mosto	Pre-filtro	Filtro-pressa
Umidità (%)	0.24	0.07	0.07
Torbidità (Abs 630 nm)	>1	0.080	0.083

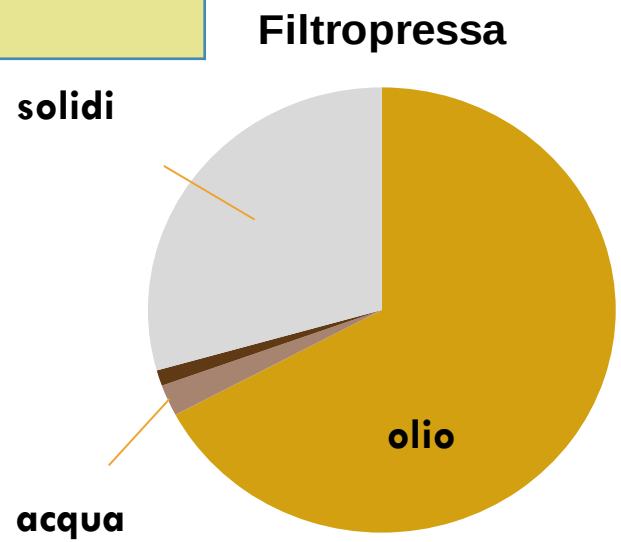
QUALITA' DELLA FILTRAZIONE

Non ci sono differenze di "qualità della filtrazione" fra le due configurazioni

	Pre-filtro	Filtro-pressa
Consumo di cartoni (per 100 kg olio)	7.6	14

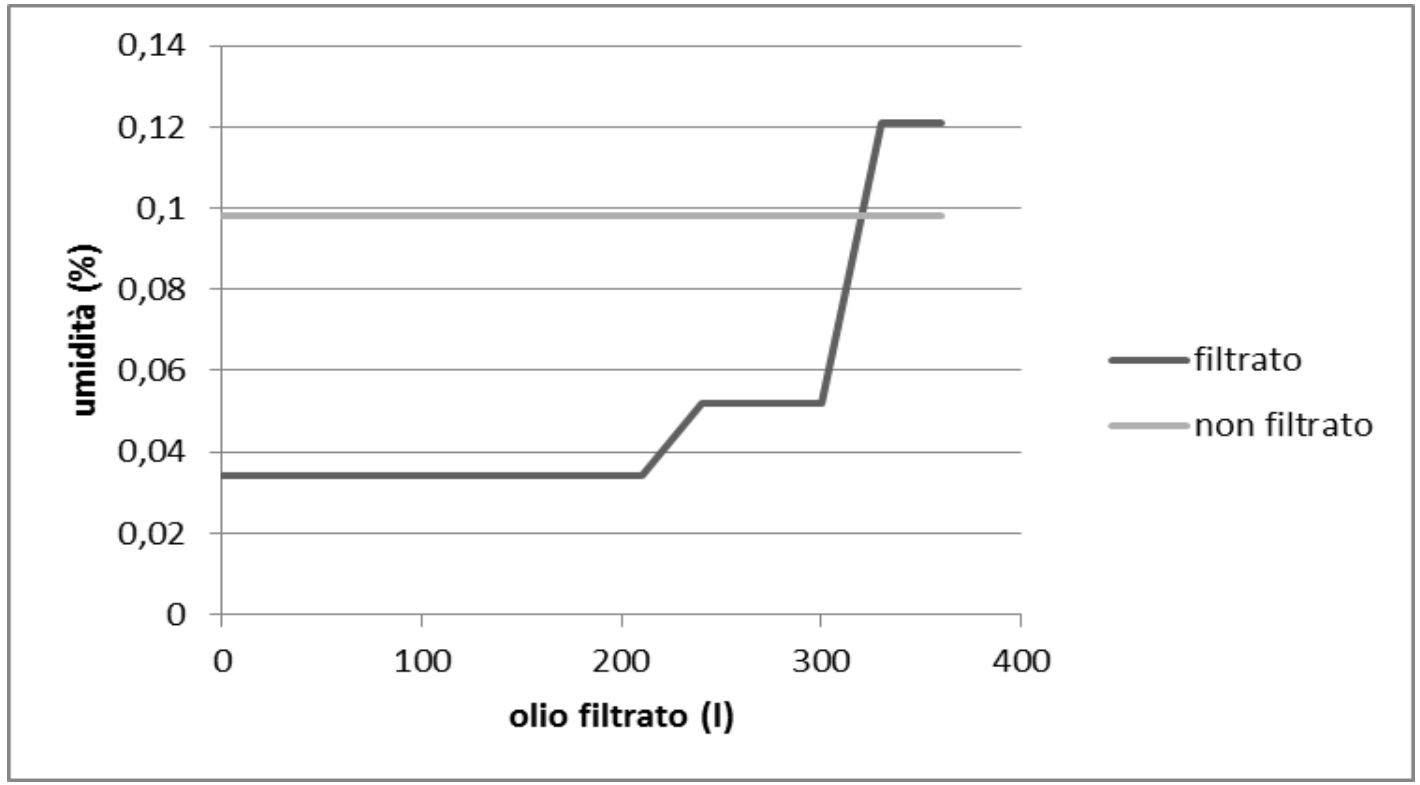
	Pre-filtro	Filtro-pressa
Olio perso (per 100 kg di olio)	2.7	5.5

	Pre-filtro	Filtro-pressa
Acqua trattenuta (g)	19,5	13,2
Olio trattenuto (g)	382	388



Nota

Il raggiungimento della pressione massima di lavoro può non essere l'unica causa di stop del ciclo di filtrazione



GRAZIE PER L'ATTENZIONE