

# Antifungal activity of Apulian macroalgal extracts



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## Microalgae



- Muriellopsis*
- Spirulina*
- Chlorella*
- Dunaliella salina*
- Dunaliella pluvialis*
- Heomatococcus pluvialis*
- Nannochloropsis oculata*
- Phaeodactylum tricornutum*
- Thalassiosira pseudonana*

## Macroalgae



- Brown algae**
  - Bifurcaria bifurcate*
  - Cystoseira tamariscifolia*
  - Fucus ceranoides*
  - Halidrys siliquosa*
  - Ecklonia kurome*
  - Cystoseira mediterranea*
  - Ectocarpus siliculosus*
- Red algae**
  - Chondrus crispus*
  - Laurencia rigida*
  - Laurencia luzonesis*
  - Solieria filiformis*
  - Agardhiella subulata*
  - Sphaerococcus cornopifolius*
  - Gracilaria gracilis*
  - Laurencia majuscula*
  - Delisea pulchra*
  - Bonnemaisonia hamifera*
  - Euclima serra*
  - Pterocladia capillacea*
  - Porphyra yezoensis*
- Green algae**
  - Enteromorpha linza*
  - Ulva rigida*

## Products

- Lutein
- Sterols
- Polysaccharide complex
- $\beta$ -carotene
- Astraxanthin
- PUFA's\*
- Phenolics**
- Sequiterpenes
- Phlorotannins
- Bromoditerpenes
- Halogenated furanones
- Lectins
- Sulphated polysaccharides
  - Fucoindans
  - Laminaran
  - Porphyran
  - Alginic acid
  - Carrageenan
  - Ulvan
- Bioactive Peptides



### The Effect of Polyphenols on Pomegranate Fruit Susceptibility to *Pilidiella granati* Provides Insights into Disease Tolerance Mechanisms

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ANTIFUNGAL ACTIVITY

## Biostimulants and fertilizers

NAME	MACROALGAL SPECIES	PRODUCER AND COUNTRY	APPLICATION
Acadian	<i>Ascophyllum nodosum</i>	Acadian Agritech - Canada	BIOSTIMULANT
Afrikelp – LG1	<i>Eklonia maxima</i>	Ed&F Man Liquid Products - Italia	BIOSTIMULANT
Agri-Gro Ultra	<i>A. nodosum</i>	Agri Gro Marketing Inc. - USA	BIOSTIMULANT
AgroKelp	<i>Macrocystis pyrifera</i>	Algas y Biod. Mar. S.A. - Messico	BIOSTIMULANT
Alga Grow	N.D.	Plagron - Italia	FERTILIZER
Alga Special	<i>A. nodosum</i>	L. Gobbi srl - Italia	FERTILIZER
Alga Tiller	<i>A. nodosum</i>	Tiller srl - Italia	FERTILIZER
AlgaCifo 3000	<i>A. nodosum</i>	Cifo srl - Italia	BIOSTIMULANT
AlgaMaxima	<i>E. maxima</i>	C.R.A. srl - Italia	BIOSTIMULANT
Algaenzims	<i>SARGASSUM</i> spp.	PALAU BIOQUIM, S.A. DE C.V - MESSICO	BIOSTIMULANT
ALGAMAR	<i>A. NODOSUM</i> , <i>SARGASSUM</i> spp., <i>LAMINARIA</i> spp., <i>M. PYRIFERA</i> , <i>EGREGIA MENZIESII</i>	QUÍMICA SAGAL, S.A. DE C.V - MESSICO	BIOSTIMULANT
ALG-A-Mic	<i>A. NODOSUM</i>	BioBizz Worldwide N.V. - SPAGNA	BIOSTIMULANT
ALGAPLUS FL	ALGHE BRUNE	ICAS - ITALIA	FERTILIZER
ALGAROOT	<i>SARGASSUM</i> spp.	PALAU BIOQUIM, S.A. DE C.V - MESSICO	ROOTING
ALIKA	N.D.	ICAS - ITALIA	FERTILIZER
BIO-GENESIS	<i>A. NODOSUM</i>	GREEN AIR PRODUCTS, INC. - USA	BIOSTIMULANT
BIOVITA	<i>A. NODOSUM</i>	PI INDUSTRIES LTD - INDIA	BIOSTIMULANT
CUAJAENZIMS	<i>Sargassum</i> spp.	PALAU BIOQUIM, S.A. DE C.V - MESSICO	BIOSTIMULANT
ESPOMA	<i>A. nodosum</i>	THE ESPOMA COMPANY - USA	BIOSTIMULANT
FARTUM	N.D.	INVERSIONES PATAGONIA S.A. - CILE	FERTILIZER
Fylloton	ALGHE BRUNE	Biolchim SPA - Italia	FERTILIZER
FRUTOENZIMS	<i>Sargassum</i> spp.	PALAU BIOQUIM, S.A. DE C.V - MESSICO	BIOSTIMULANT
Guarantee	<i>A. nodosum</i>	Ocean Organics – Nuova Zelanda	BIOSTIMULANT
Kelp Meal	<i>A. nodosum</i>	Acadian Seaplants Ltd - Canada	BIOSTIMULANT
Kelpak	<i>E. maxima</i>	BASF - Germania	BIOSTIMULANT
Kelpro	<i>M. pyrifera</i> , <i>E. menziesii</i>	Tecniprocessos Biol., S.A. de C.V. - Messico	BIOSTIMULANT
Kelprolizer	<i>M. pyrifera</i>	Productos del Pacifico, S.A de C.V - Messico	FERTILIZER
Kelproot	<i>M. pyrifera</i> , <i>Gelidium robustum</i>	Algas y Extractos del Pacifico Norte, S.A. de C.V - Messico	ROOTING
Kelprosoil	<i>M. pyrifera</i>	Productos del Pacifico, S.A de C.V - Messico	BIOSTIMULANT
Maxicrop	<i>A. nodosum</i>	Maxicrop USA, Inc. - USA	BIOSTIMULANT
Mc Cream	<i>A. nodosum</i>	Valagro - Italia	BIOSTIMULANT
Mc Extra	<i>A. nodosum</i>	Valagro - Italia	BIOSTIMULANT
Nitrozime	<i>A. nodosum</i>	Hydrodynamics International Inc. - USA	BIOSTIMULANT
NPKelp	<i>M. pyrifera</i> , <i>G. robustum</i>	Algas y Extractos del Pacifico Norte, S.A. de C.V - Messico	FERTILIZER
Profert	<i>Durvillaea antarctica</i>	BASF - Germania	BIOSTIMULANT
Red Bloc SW	Alghe rosse	ICAS - Italia	FERTILIZER
Sea Winner	N.D.	China Ocean Univ. Product Dev. Co., Ltd - Cina	BIOSTIMULANT
Seanure	N.D.	Farmura Ltd. – UK	BIOSTIMULANT
Seasol	<i>Durvillaea potatorum</i>	Seasol International Pty Ltd - Australia	BIOSTIMULANT
Seaweed	<i>M. pyrifera</i>	Algas Marinas, S.A. de C.V - Messico	BIOSTIMULANT
Soluble SW Extract	<i>A. nodosum</i>	Technaflora Plant Products, LTD - Canada	BIOSTIMULANT
Stimplex	<i>A. nodosum</i>	Acadian Agritech - Canada	BIOSTIMULANT
Synergy	<i>A. nodosum</i>	Green Air Products, Inc - USA	BIOSTIMULANT
Turboenzims	<i>Sargassum</i> spp.	Palau Bioquim, S.A. de C.V - Messico	BIODUCER
Vitalex	N.D.	Química Sagal, S.A. de C.V - Messico	FERTILIZER



## BROWN ALGAE

### *Ascophyllum nodosum*



ASCOPHYLLUM  
NODOSUM  
EXTRACT

LEAF  
APPLICATION

ROOT  
APPLICATION

IMPROVED  
RESISTANCE TO  
BIOTIC STRESSES

CONTROL OF  
FRUIT AND  
LEAF DISEASES

IMPROVED  
RESISTANCE TO  
WATER STRESSES

ROOT  
DEVELOPMENT

IMPROVEMENT OF  
NITROGEN FIXATION

GROWTH  
IMPROVEMENT

IMPROVED  
RESISTANCE TO  
ABIOTIC  
STRESSES

IMPROVEMENT  
OF  
ORGANOLEPTIC  
FEATURES

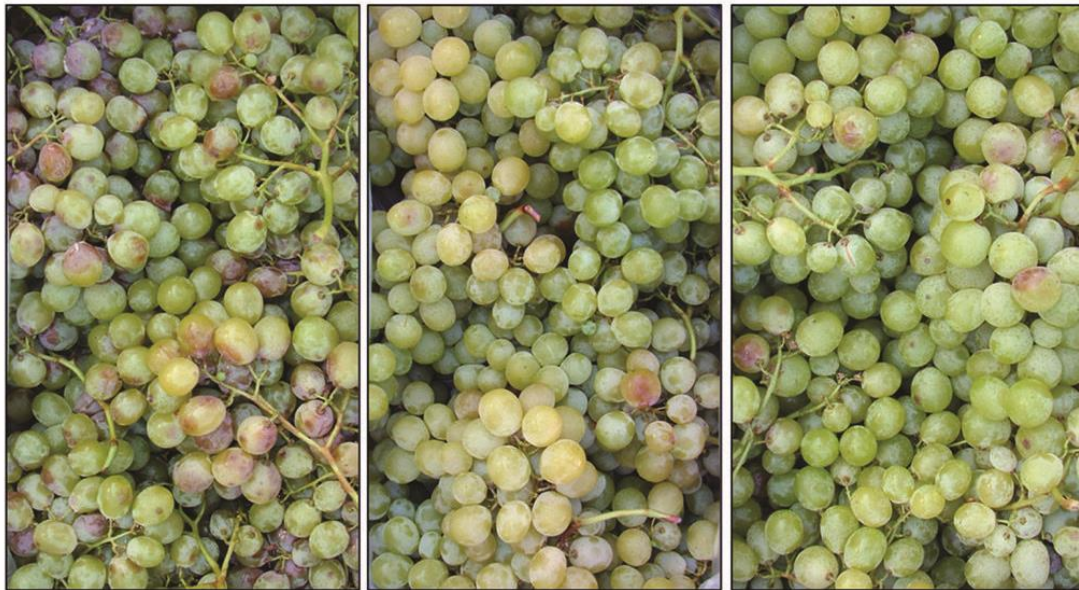
CONTROL OF SOIL  
PATHOGENS AND  
PESTS

Bottalico A., Mincuzzi A., 2021. L'uso delle macroalghe in agricoltura. In: Microalghe (e cianobatteri). (Ed. Sellitto V.M.), Edagricole-New Business Media, Milano, Italia. ISBN-13:9788850656141.

## RED ALGAE

Previous trials with a commercial product:

TABLE GRAPE



CONTROL

RED SEAWEED  
EXTRACT

CHEMICAL



SWEET CHERRY

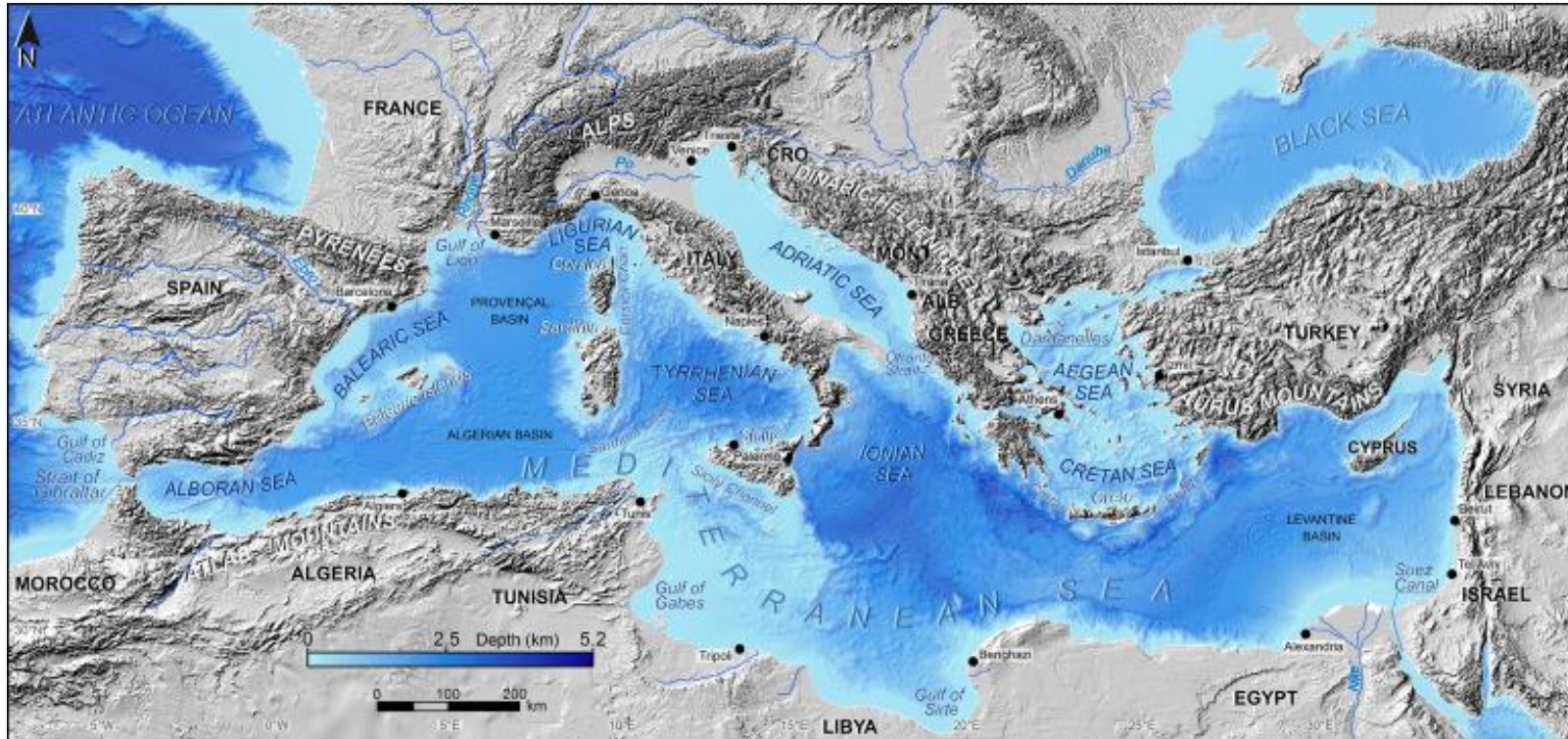


CONTROL

RED SEAWEED  
EXTRACT

CHEMICAL





## TEST ANTIFUNGAL EFFECTIVENESS OF EXTRACTS OBTAINED BY MEDITERRANEAN SEAWEEDS



# Mediterranean species

## RED ALGA



***Halopithys incurva***  
(Hudson) Batters

## GREEN ALGA



***Codium vermilara***  
(Olivi) Delle Chiaje

## RED ALGA



***Laurenciella marilzae*** (Gil-Rodríguez, Senties, Díaz-Larrea, Cassano & M.T. Fujii) Gil-Rodríguez, Senties, Díaz-Lorraea, Cassano & M.T. Fujii)

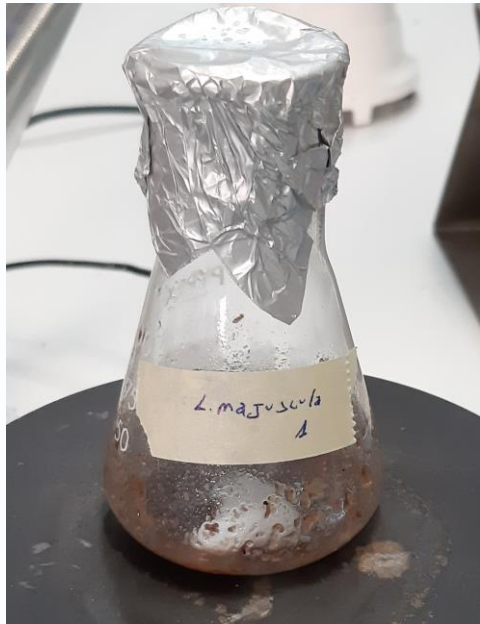
# Seaweed dehydration



- Washing
- Epiphyte removal
- Stove dehydration  
( $55 \pm 1$  °C for 4 days)

Polverization: dipping in **liquid Nitrogen** and **blending**.

## Seaweed extract



- Supernatant filtration
- Storage at  $-80 \pm 1$  °C



Double maceration of algal powder in  $H_2O:EtOH$  (80:20) acidified (0.1% HCl).

**Centrifugation**



Metabolite fingerprinting of *Punica granatum* L. (pomegranate) polyphenols by means of high-performance liquid chromatography with diode array and electrospray ionization-mass spectrometry detection

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# Total polyphenols

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## Thermal Processing Enhances the Nutritional Value of Tomatoes by Increasing Total Antioxidant Activity

Veronica Dewanto, Xianzhong Wu, Kafui K. Adom, and Rui Hai Liu

View Author Information

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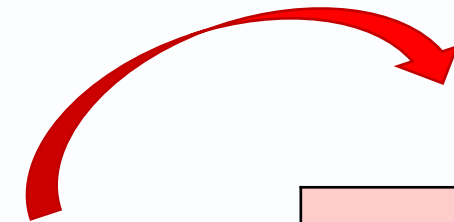
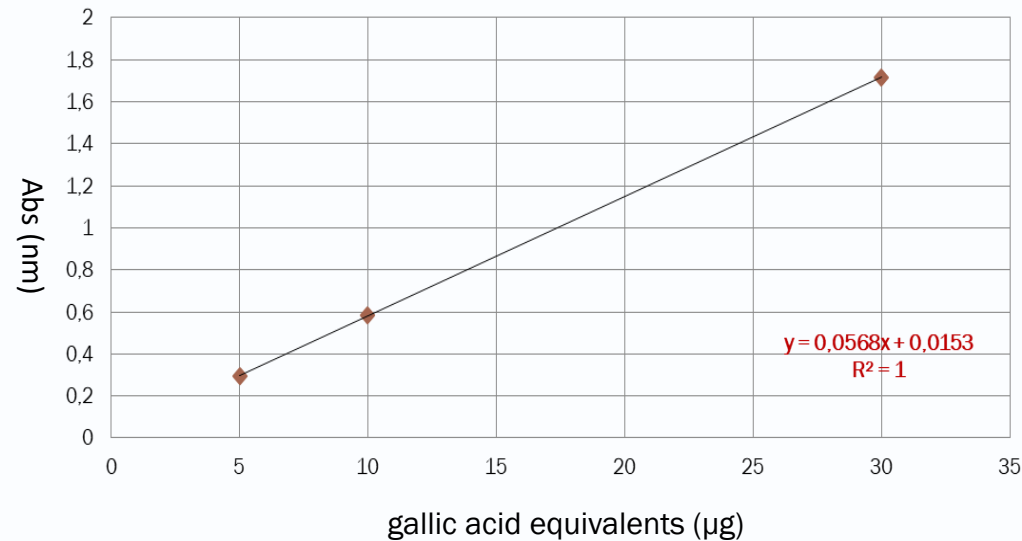
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- Cold extraction
- Spectrophotometric assay (760 nm);



	Total polyphenols (µg/mL)
LM <sub>1</sub>	12,14
LM <sub>2</sub>	11,2
HI <sub>1</sub>	57,8
HI <sub>2</sub>	56,2
CV <sub>1</sub>	3,1
CV <sub>2</sub>	3,5

# In vitro micro-spectrophotometric assay

## An automated quantitative assay for fungal growth inhibition

Willem F. Broekaert, Franky R.G. Terras, Bruno P.A. Cammue and Jos Vanderleyden

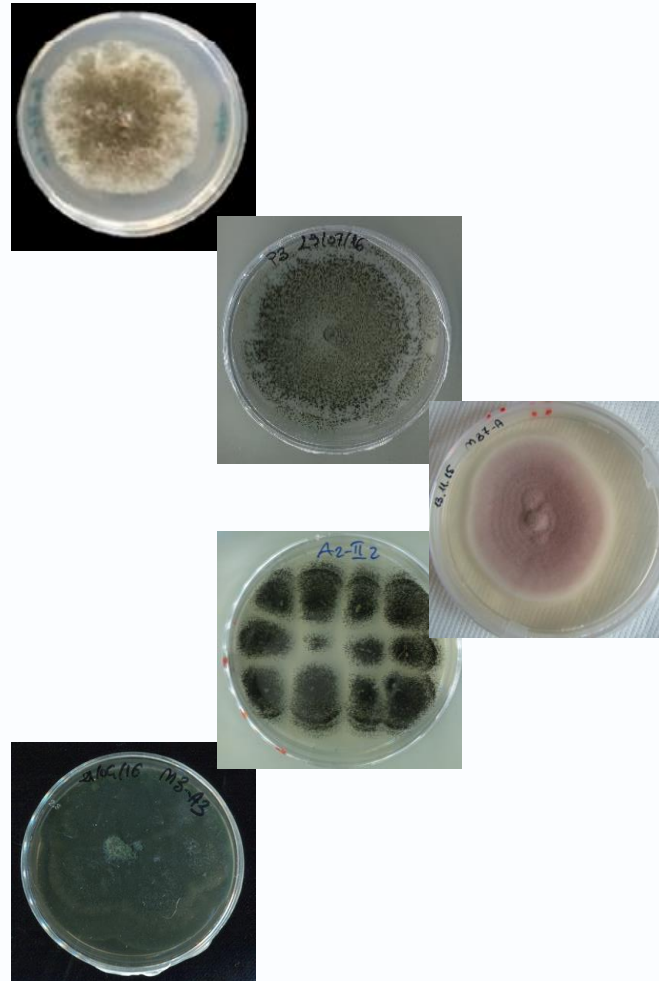
F.A. Janssens Memorial Laboratory of Genetics, University of Leuven, Heverlee, Belgium

Received 20 October 1989  
Revision received and accepted 4 December 1989

Key words: Growth inhibition assays; Filamentous fungi; Microplate reader

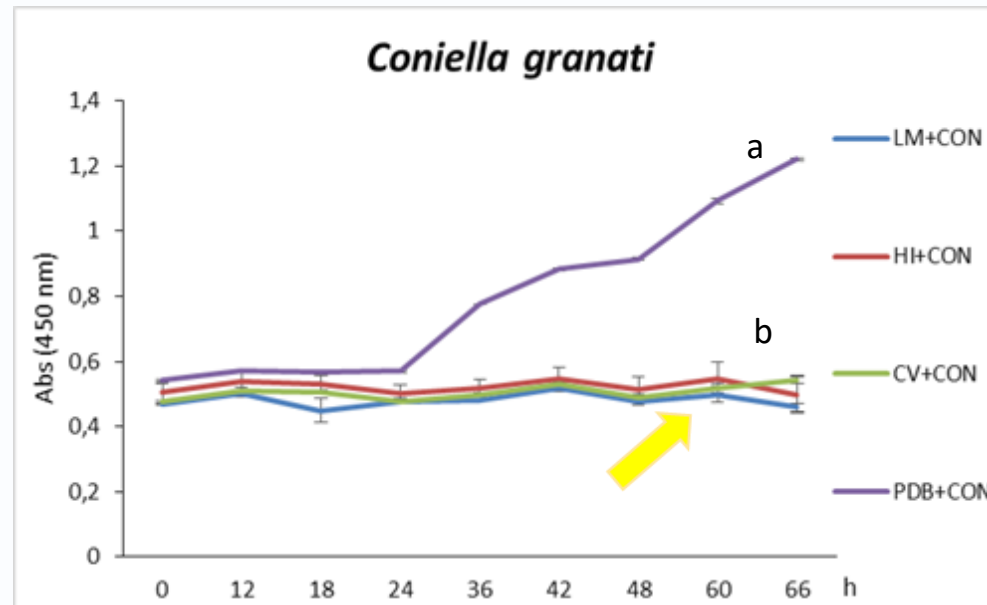
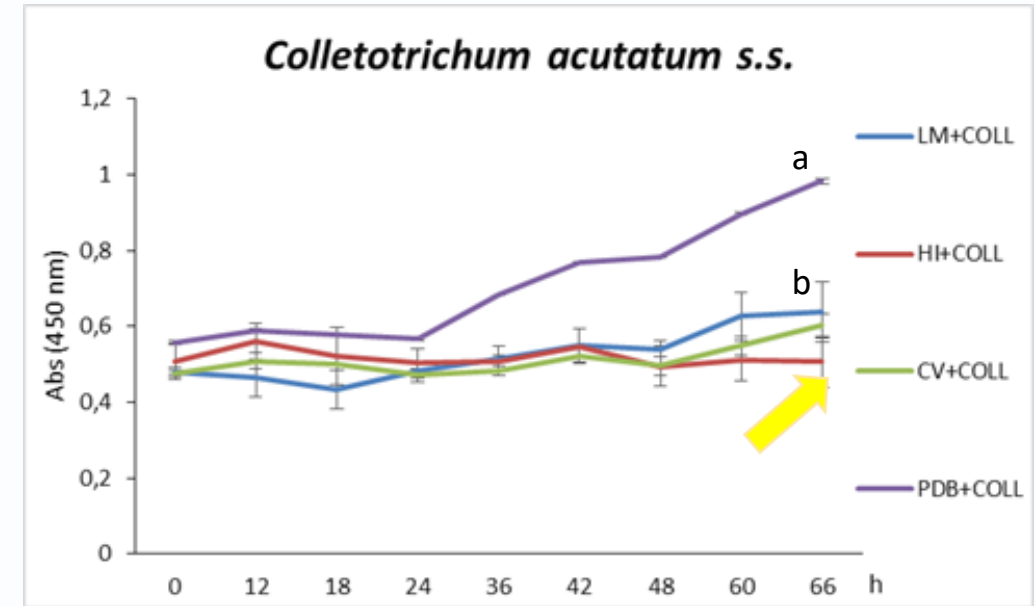
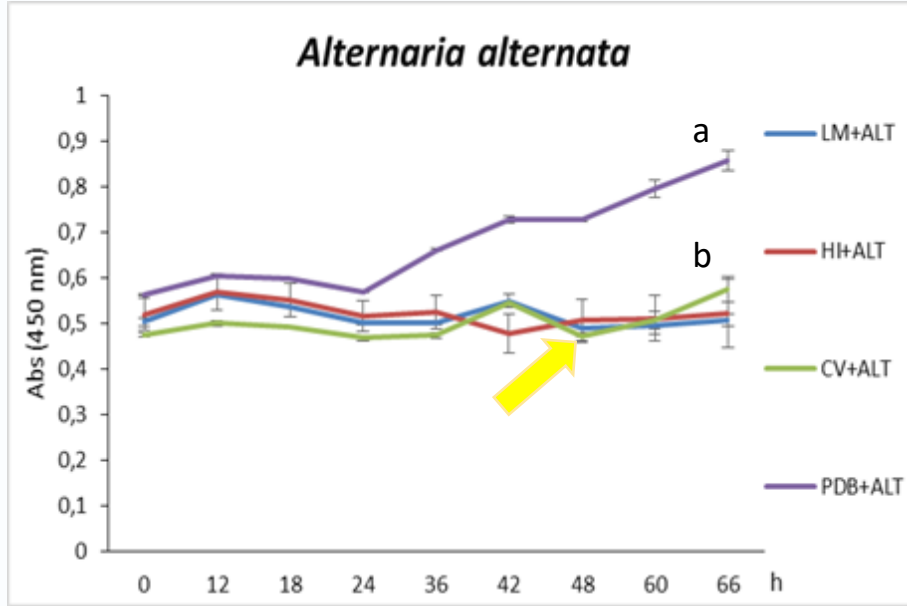
## POSTHARVEST FUNGAL PATHOGENS OF POMEGRANATES

- *Alternaria alternata* (Fr.) Keissl.
- *Coniella granati* (syn. *Pilidiella granati*) (Sacc.) Petr. & Syd
- *Colletotrichum acutatum sensu stricto* (s.s., Simmonds)
- *Aspergillus welwitschiae* (Bres.) Henn.
- *Penicillium glabrum* (Wehmer) Westling



- 40  $\mu$ L seaweed extract + 150  $\mu$ L PDB + 10  $\mu$ L conidial suspension ( $2 \times 10^4$  conidia/mL);
- $\lambda = 450$  nm;
- Incubation at  $24 \pm 1$  °C in the dark. Growth was monitored for 66 h.

# In vitro micro-spectrophotometric assay

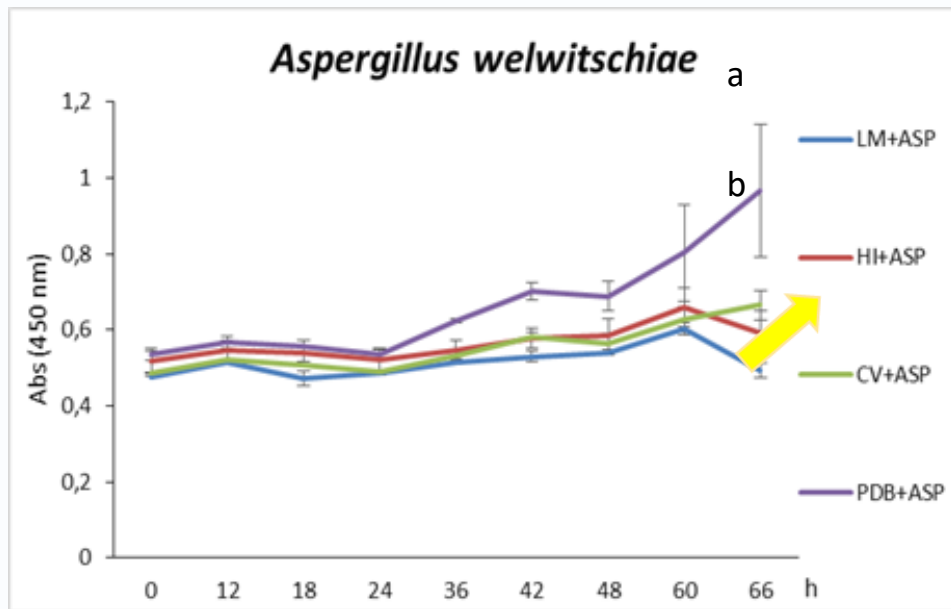


↑  
-30%

↑  
GROWTH INHIBITION →

LM  
HI  
CV  
Control

# In vitro micro-spectrophotometric assay



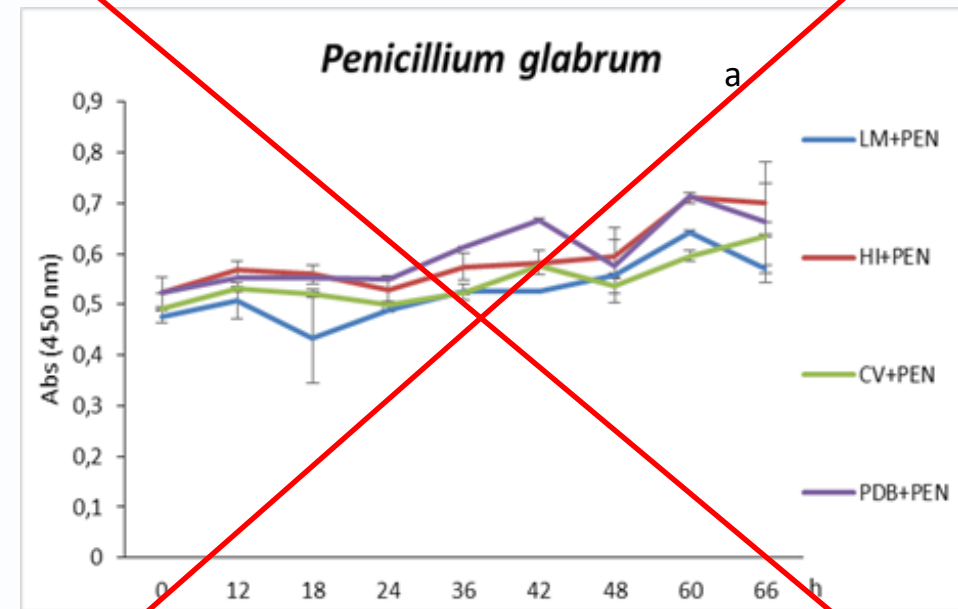
LM

HI

CV

Control

↑  
-50%



NO EFFECTIVENESS

# Conclusions

- Seaweed extracts are **poliphenol rich**.
- Poliphenol amount in **CV extract** is **1-fold lower** than **red seaweeds**
- Sporification of ***A. alternata*** and ***C. granati*** is **fully inhibited** by seaweed extracts.
- Growth of ***C. acutatum s.s.*** and ***A. welwitschiae*** is **reduced** by **30%** and **50%**, respectively
- **No** fungistatic/fungicide **effectiveness** against ***P. glabrum***



Putative **qualitative** antifungal effectiveness



- **Chemical characterization** of **polyphenolic compounds**
- Assessment of **dose-effect** and Minimum inhibitory concentration (**MIC**)



*Thank you!!!*

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