



Biomassa residua e chimica verde:  
opportunità per l'innovazione con il legno  
di castagno.

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**Università degli Studi della Tuscia**

**Viterbo**

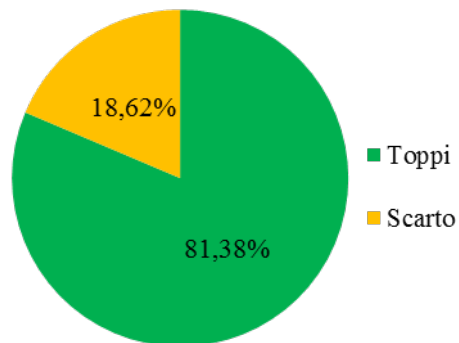


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## Biomassa residua

Prima lavorazione - volume  
(%)

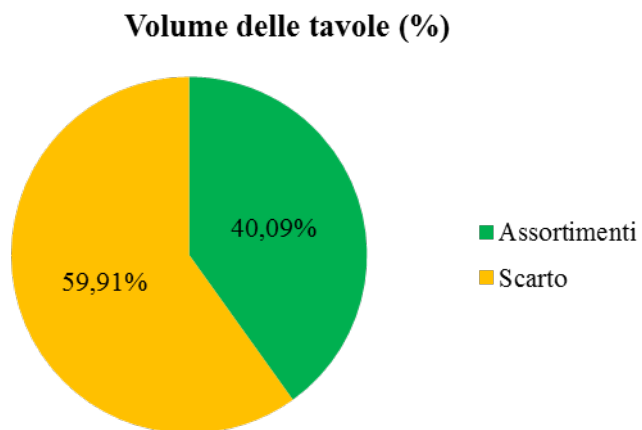




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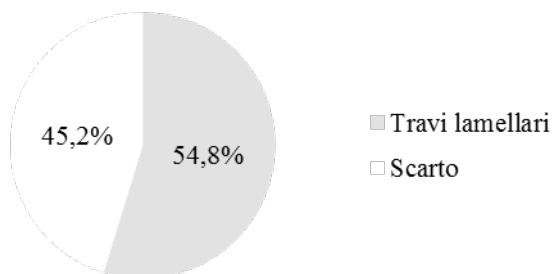


## Biomassa residua

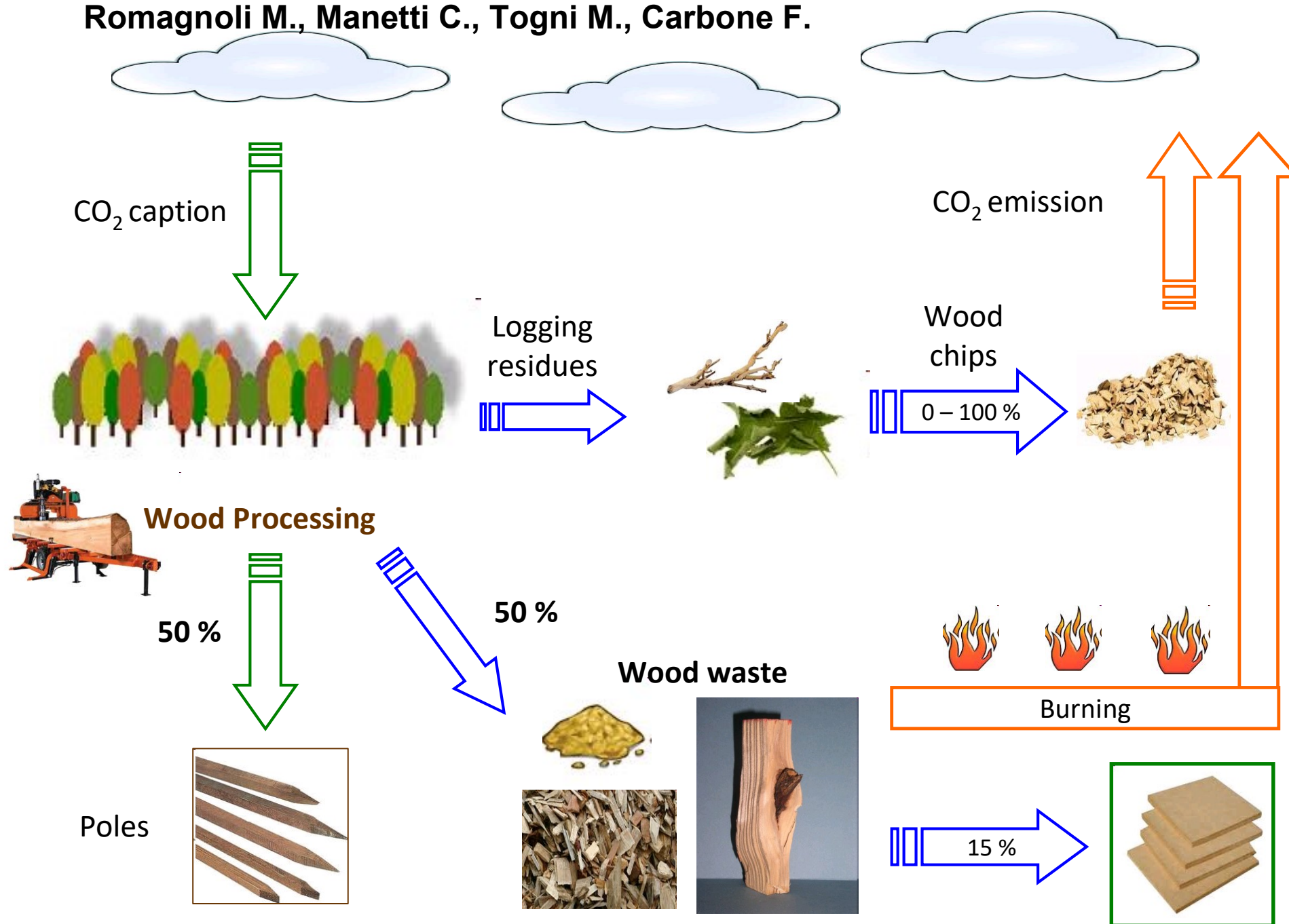




Travi lamellari - percentuale

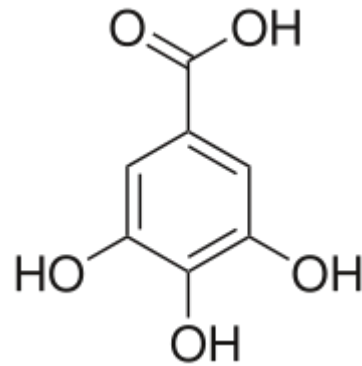


Romagnoli M., Manetti C., Togni M., Carbone F.

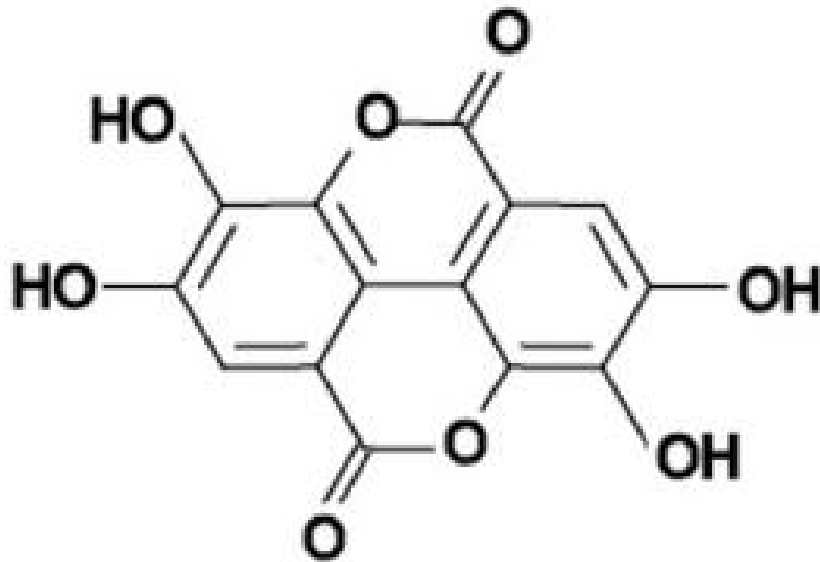


# Tannini idrolizzabili

- - gallotannini
- - ellagitannini

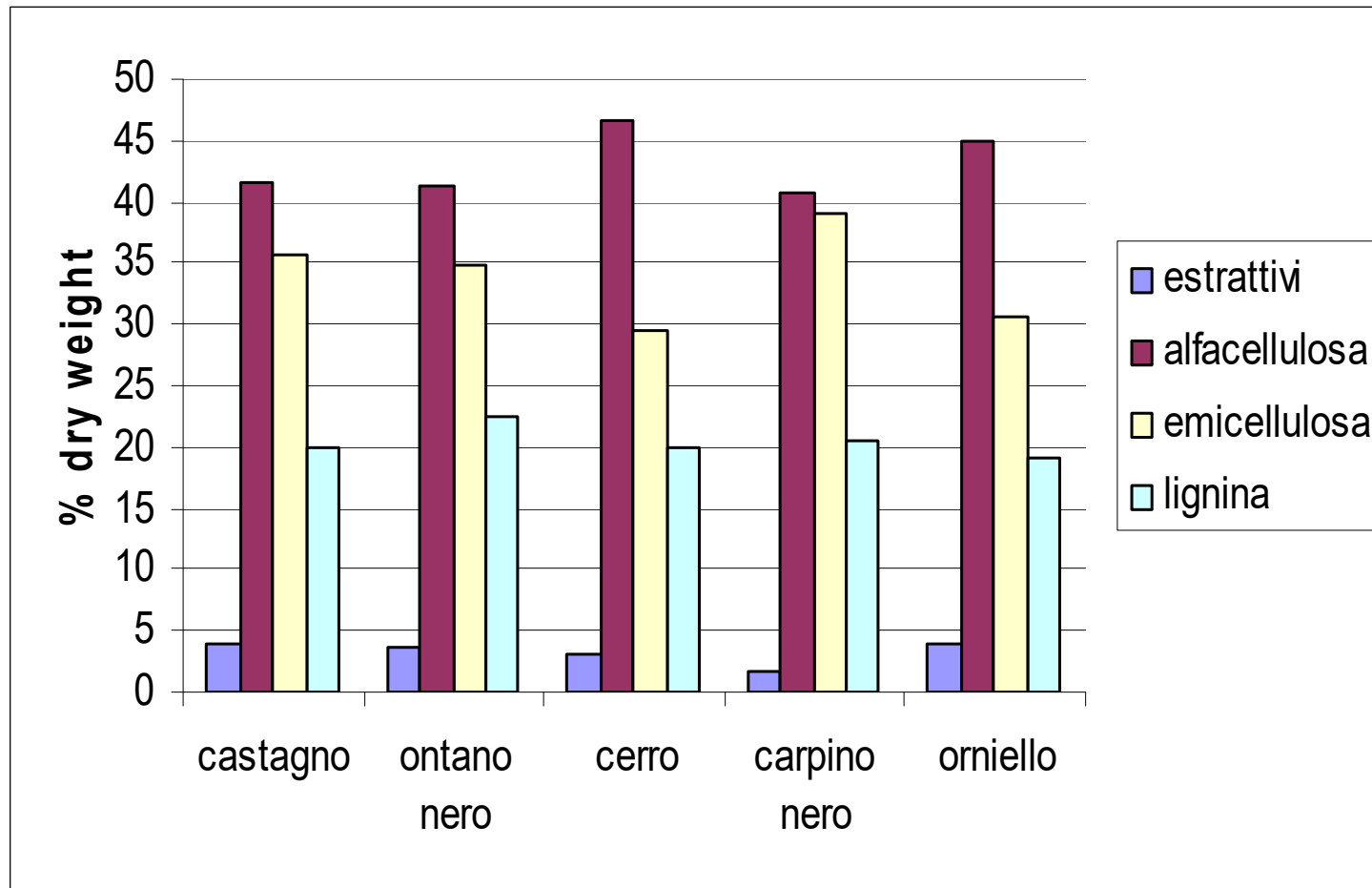


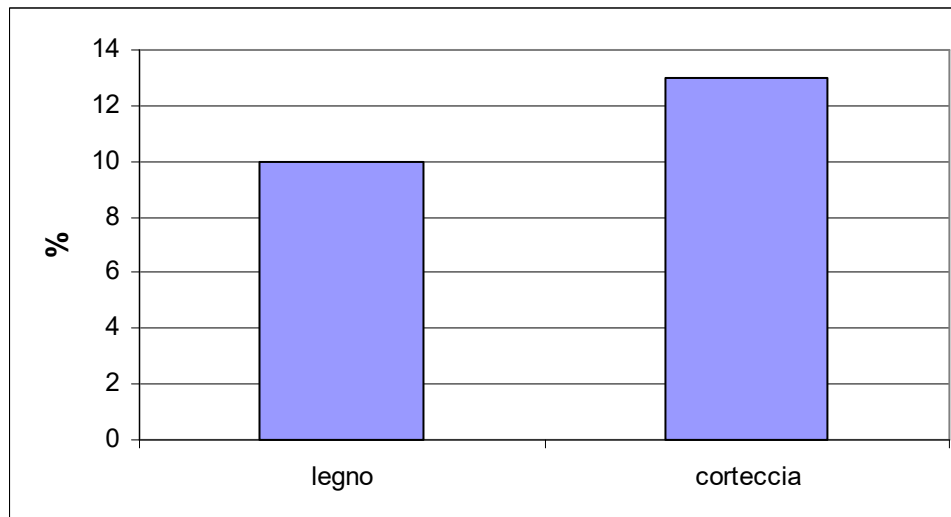
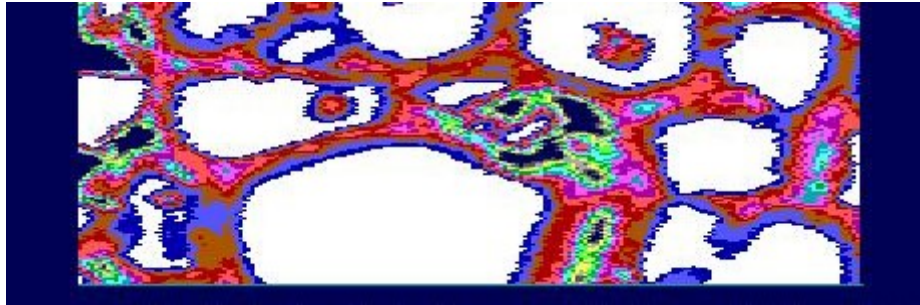
Acido gallico



Ellagitannini

# Composizione chimica legno di castagno





**Percentuale di polifenoli in legno e corteccia**

**vescalina, castalagina....**



# Tannini

## Tannati metallici

- a. (lacche colorate, inchiostri..)
- b. (metalli pesanti ed alcaloidi precipitano come tannati insolubili)

Antiemostatici

Astringente

Antiossidante





## Enological potential of chestnut wood for aging Tempranillo wines part I: Volatile compounds and sensorial properties

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M.C. Díaz-Maroto <sup>c</sup>, M.S. Pérez-Coello <sup>a</sup>

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I vini invecchiati con botti di castagno, in un periodo di sei mesi hanno fornito i migliori risultati

# I tannini come adesivo



Table 2. TMA results: average value of MOE maximum and maximum temperature at which full curing occurs for different proportions of PF/Chestnut tannin in the adhesive formulations

Phenol/Chestnut tannin ratio	Average value of maximum MOE (MPa)	Temperature at MOE max (°C)
50/50	4109	170
45/55	4002	170-180
40/60	4135	185
35/65	3866	170-190
30/70	3264	180
20/80	3117	185-220
10/90	3162	200-230
0/100	2231	>240

S.Spina, X.Zhou, C.Segovia, A.Pizzi, M.Romagnoli, S.Giovando, H.Pasch, K.Rode, L.Delmotte, 2011. J. of Adhesion Science. In print

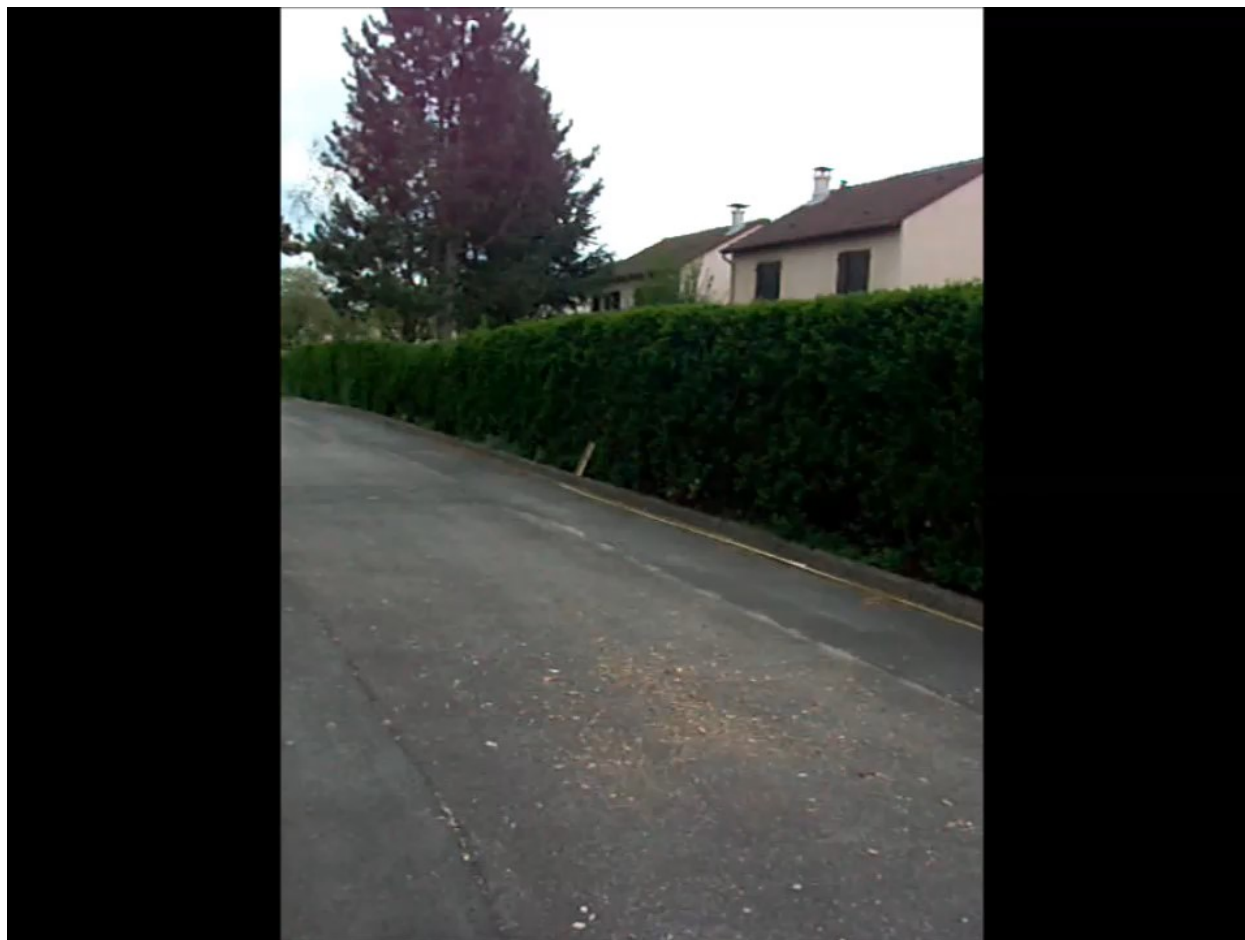
Schiume di  
tannini



Additivo nella dieta  
animale

antiossidante





**Table 1**

Significant anthropogenic sources of heavy metal in the environment.

Industry	Metals	Pollution arising	References
Electroplating	Cr, Ni, Zn, Cu	Liquid effluents from plating processes	[22,23]
Batteries	Pb, Sb, Zn, Cd, Ni, Hg	Waste battery fluid, contamination of soil and groundwater	[24]
Paints and pigments	Pb, Cr, As, Ti, Ba, Zn	Aqueous waste from manufacture, old paint deterioration and soil pollution	[25]
Landfill leachate	Zn, Cu, Cd, Pb, Ni, Cr, Hg	Landfill leachate, contamination of ground and surface water	[26,27]
Electronics	Pb, Cd, Hg, Pt, Au, Cr, As, Ni, Mn	Aqueous and solid metallic waste from manufacturing and recycling process	[28]
Metalliferous mining	Cd, Cu, Ni, Cr, Co, Zn, As	Acid mine drainage, tailings, slag heaps	[29,30]
Fertilizers	Cd, Cr, Mo, Pb, U, V, Zn	Run-off, surface and groundwater contamination, plant bioaccumulation	[31,32]
Manures sewage sludge	Zn, Cu, Ni, Pb, Cd, Cr, As, Hg	Land spreading threat to ground and surface water	[31,33]
Specialist alloys and steels	Pb, Mo, Ni, Cu, Cd, As, Te, U, Zn	Manufacture, disposal and recycling of metals. Tailings and slag heaps	[34,35]
Paper and pulp	Zn, Cu, Cd, Pb, Ni, Fe, Mn	Wastewater effluents	[36]

# Bio assorbenti per applicazioni ambientali

- Tannini immobilizzati
- Schiume di tannini
- Gel di tannini

Recupero di oro, argento,  
Platino, palladio,

Cromo

Piombo

Rame

Zinco

Nichel

tensioattivi

# Valorization of solid wastes from chestnut industry processing: Extraction and optimization of polyphenols, tannins and ellagitannins and its potential for adhesives, cosmetic and pharmaceutical industry



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I residui delle castagne hanno elevato contenuto di tannini che possono essere utilizzati come sostituti nella formulazione di adesivi o come antiossidanti nel cibo, cosmetica, composti farmaceutici

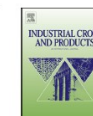
Industrial Crops and Products 73 (2015) 99–105



Contents lists available at ScienceDirect

Industrial Crops and Products

journal homepage: [www.elsevier.com/locate/indcrop](http://www.elsevier.com/locate/indcrop)



Antioxidant and deodorizing activities of phenolic components in chestnut inner shell extracts



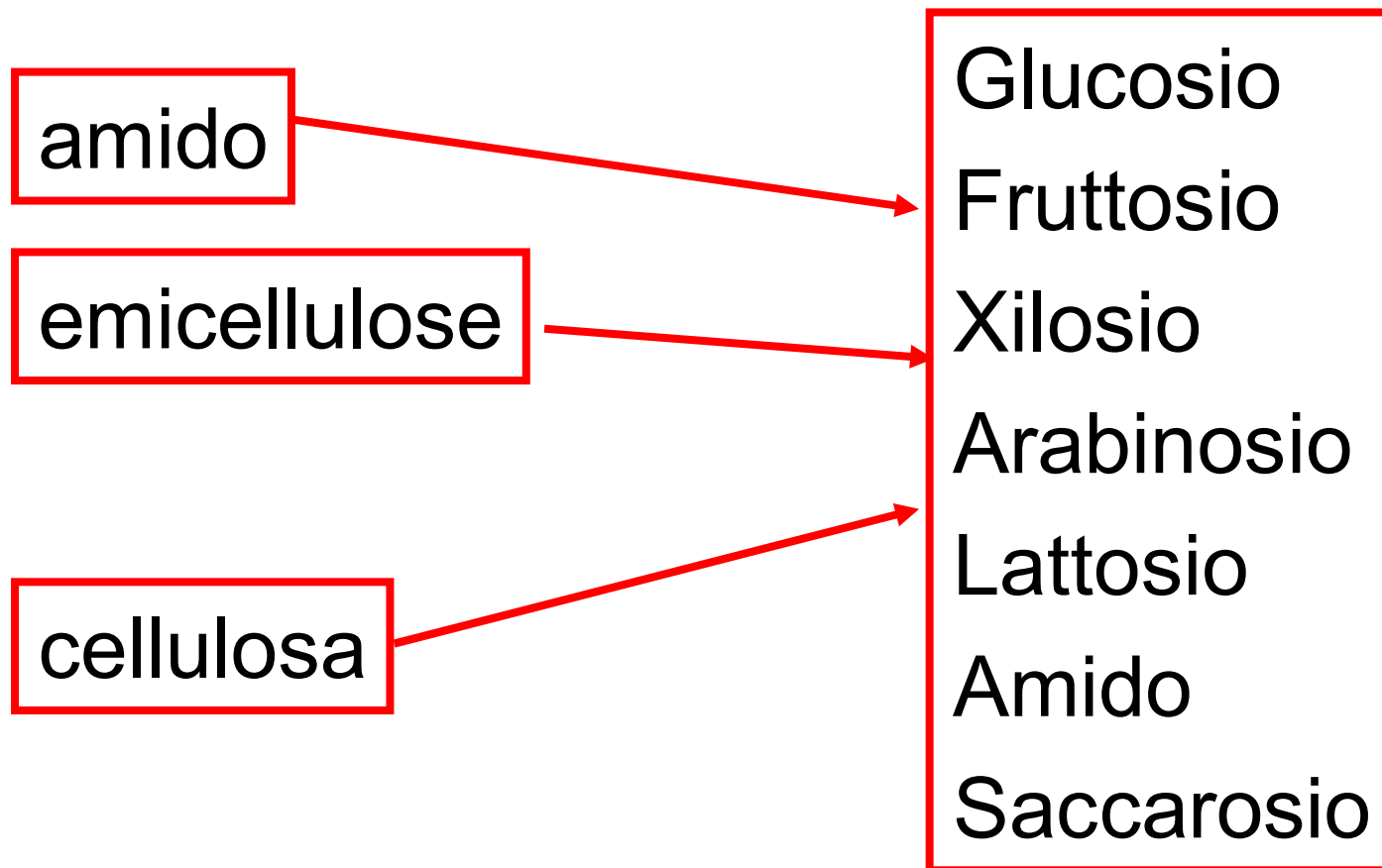
Ji-Sun Ham <sup>a</sup>, Hee-Young Kim <sup>b</sup>, Seung-Taik Lim <sup>a,\*</sup>

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# Piattaforma chimica della bioraffineria: amido, emicellulose, cellulosa



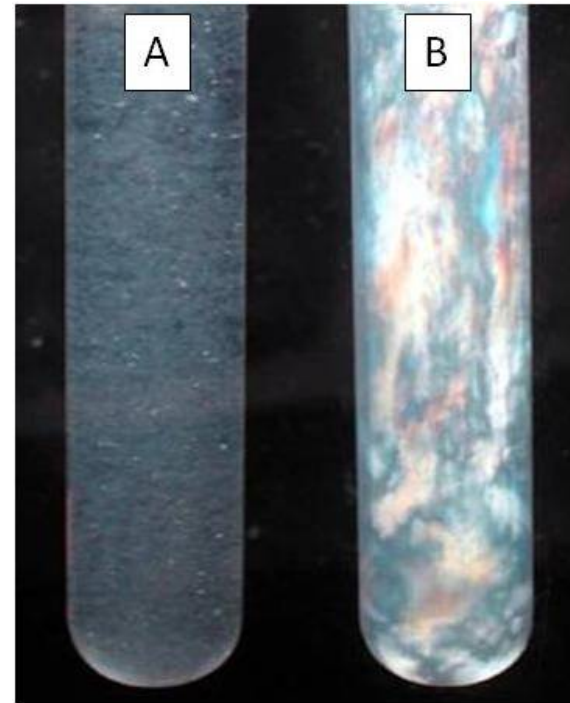
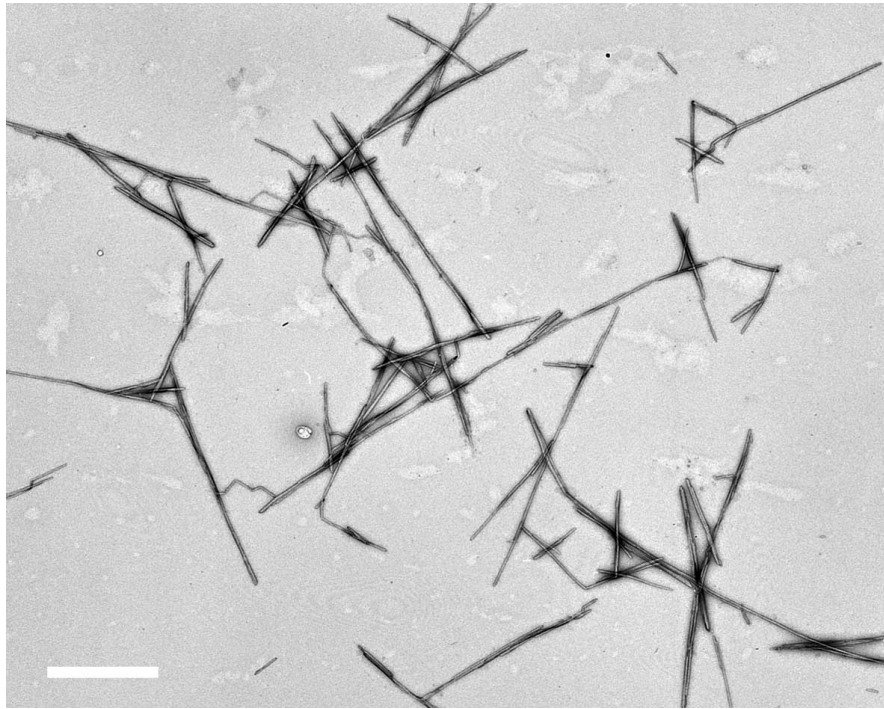
# Piattaforma chimica della bioraffineria: gli zuccheri

	Galattosio %	Glucosio %	Mannosio %	Arabinosio %	Xilosio %
Conifere	9.8	64.5	12.0	3.3	10.3
Latifoglie	2.3	65.2	2.6	1.5	28.3

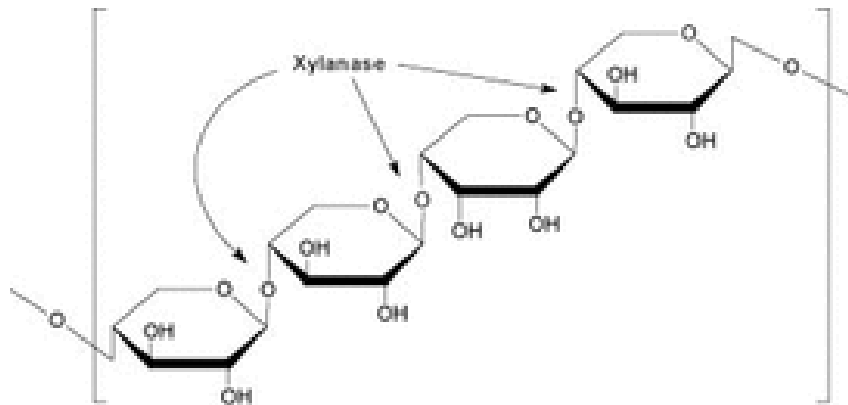
**Vidrich, 1988**

# Piattaforma chimica della bioraffineria: cellulosa

fibra di cellulosa



# Piattaforma chimica della bioraffineria: emicellulose



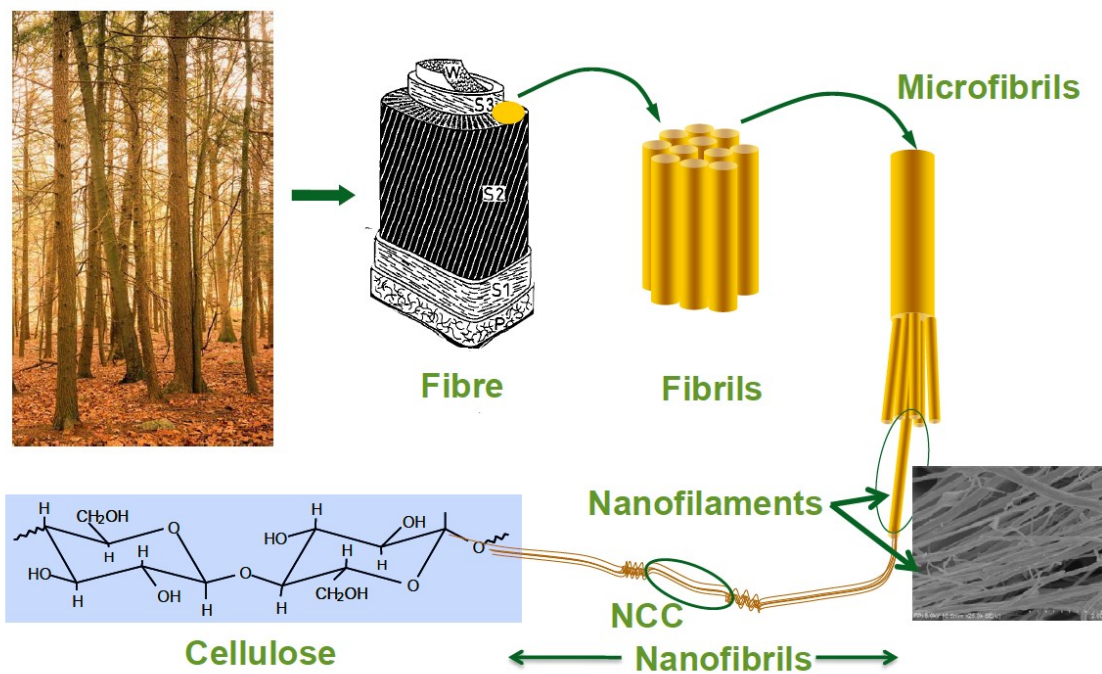
D-xilosio  
L-arabinosio  
D-mannosio  
L-ribosio

**Intermediari chimici, ingredienti per prodotti Cosmetici, additivi per diete, films, rivestimenti**



## Cellulosa

Per  
 cortesia  
 di  
 Elena  
 Fortunati





Nanocellulose type	Diameter	Length	Crystallinity
NanoFibrillar Cellulose (NFC)	20 - 300 nm	> 2,000 nm	< 70%
NanoCrystalline Cellulose (NCC)	3 - 5 nm	50 - 500 nm	up to > 90%
Bacterial cellulose (BCC)	10 - 100 nm	100 to >1000 nm	~70%

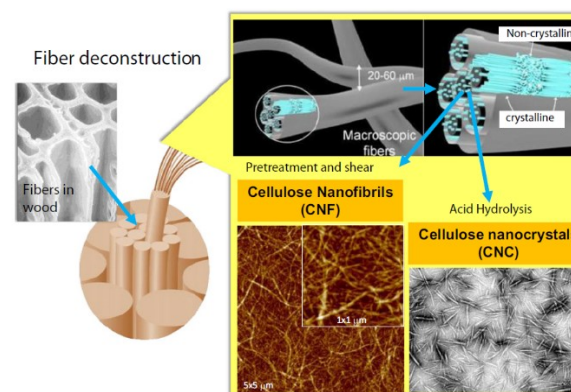
◆ High crystalline structure

◆ Large aspect ratio  
(ca. 70)

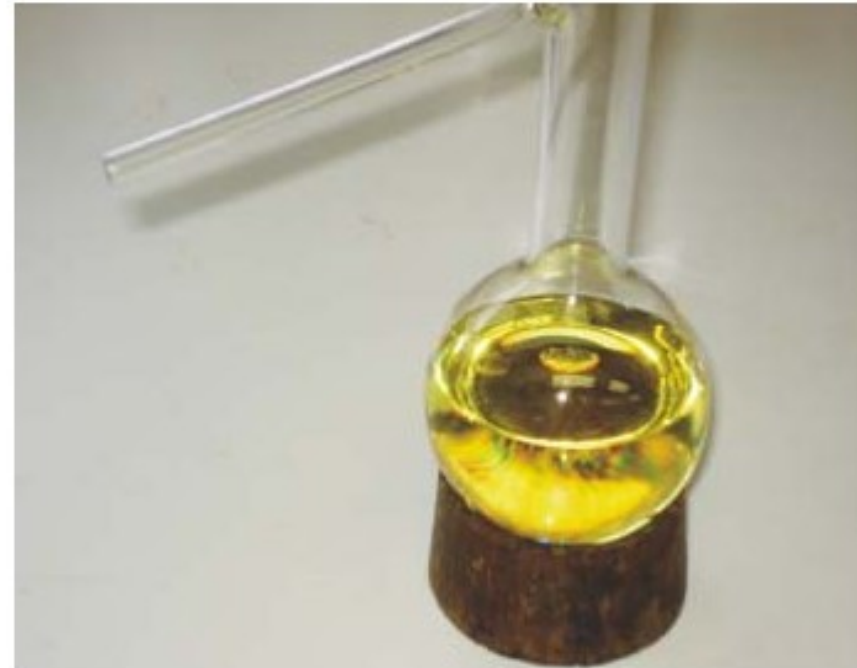
Fortunati, et al., Journal of Food Engineering 2013, 18, 117-124.  
Fortunati, et al., Carbohydrate Polymers, 2013.

Fortunati, et al., Polym Degrad Stab, 2012, 97, 2027-2036.

◆ High surface area  
(ca. 150 m<sup>2</sup>/g)



# Altri derivati: furfurolo

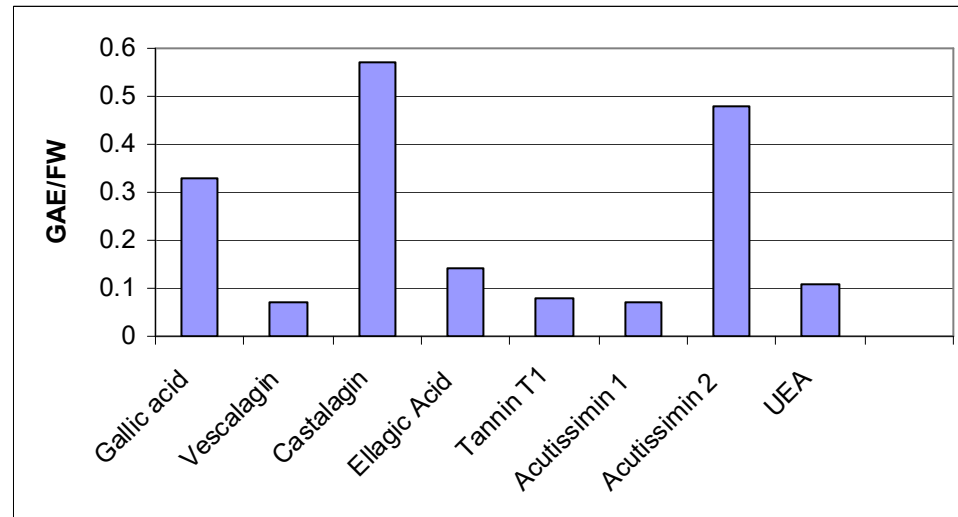


Furfural is an aromatic liquid of yellow-ish colour. It is used for the production of furfuryl alcohol, at refination in petroleum industry or as a supplement to diesel and other motor fuels.

Ottenuto per idrolisi acida ad elevata temperatura, strada non più percorribile per l'elevato contenuto di acido acetico nelle acque reflue

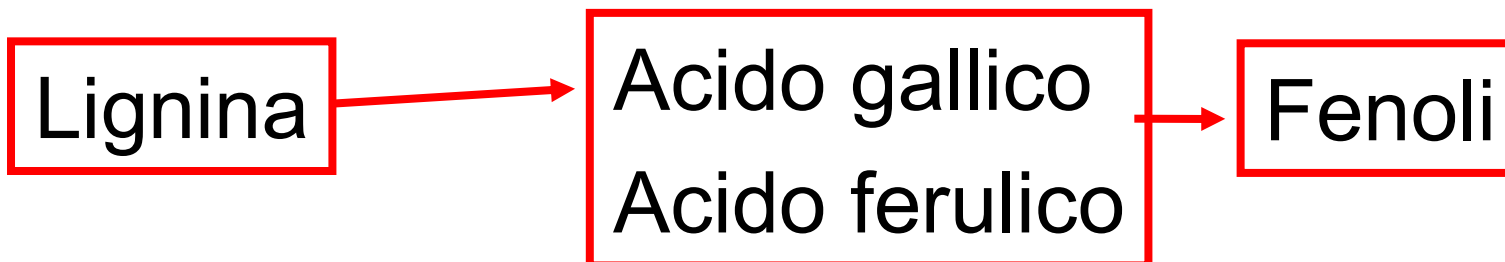
Derivati del furfurolo: Alcol furfurilico (2,5 idrossi-metil-furano)

# Il sistema bosco di castagno



**Total phenolic content 84.87**

# Piattaforma chimica della bioraffineria: lignina





**Grazie per l'attenzione**

# Possibili ulteriori risorse nel breve medio periodo

Zinco



Germanio



Bagno acido con celle elettrolitiche di purificazione dello zinco. I tannati sono poi inseriti in forni che eliminano i residui organici