

Magnetic nanoparticles in beverage industry

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InoVine – who are we

InoVine – spin off from IJS - engineering and consulting company, specialized in processing technologies for the wine and beverage industry

- prof. dr. Marin Berovič
- Uroš Pečaver
- doc. dr. Sašo Gyergyek
- Milan Vitas
- Miha Kavčič
- dr. Stanislav Čampelj



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Nanoparticles in beverage industry

- Why use the nanoparticles?
- What properties are required?
- When to use them?

Sparkling wine (champagne, prosecco, cava...)

Production of sparkling wine:

- 1st fermentation – production of still wine, all sugars are fermented
- Addition of sugar (determine the overpressure) and yeast (champagne strain)
- Mixture is in filled in special bottles (traditional method), crown cap
- 2nd fermentation in bottle (traditional method and ancestral method)
- After 2nd fermentation wine lies on yeast, lees for 18+ months
- Bottles are gradually positioned to vertical position (2-10 weeks)
- Sediment is gathered in bottle's neck
- Neck is cooled and bottle opened – pressure pushes the sediment
- Addition of liqueur and bottle is closed with cork cap

Clarification – riddling or *remuage* (fr.)

The most time consuming step in production, gravity driven
Traditional way – bottles are rotated by hand, each time slightly more vertical

Modern way – bottles are stacked on gyropaletts

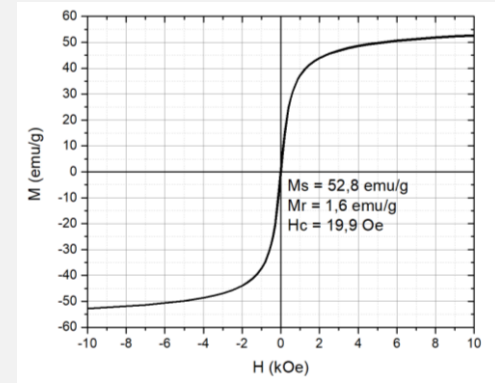
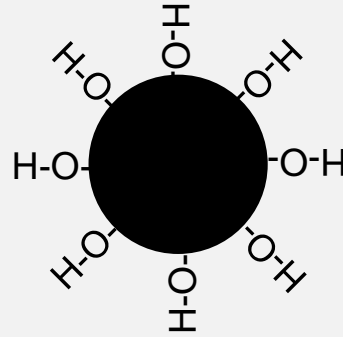


Goal: shorten time and reducing the cost of riddling

Functionalization of particles

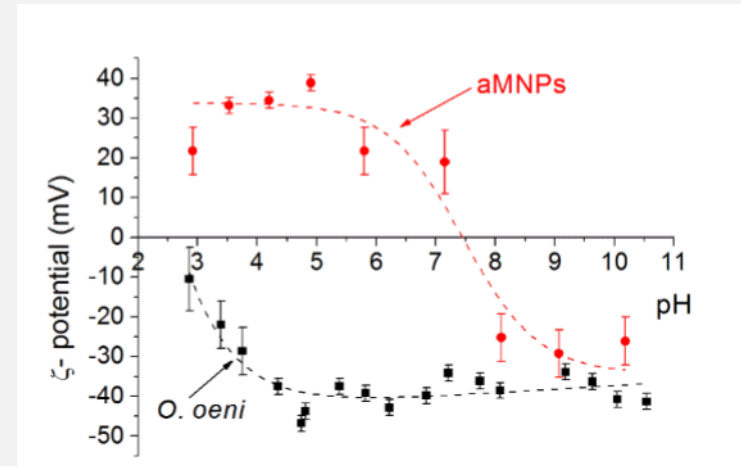
Nanoparticles – as synthesized

- Superparamagnetic γ -Fe₂O₃
- Hydrated surface
- Non-specific adsorption
- Pronounced agglomeration
- Dissolves at pH 3,5 (wine)



Microorganisms surface

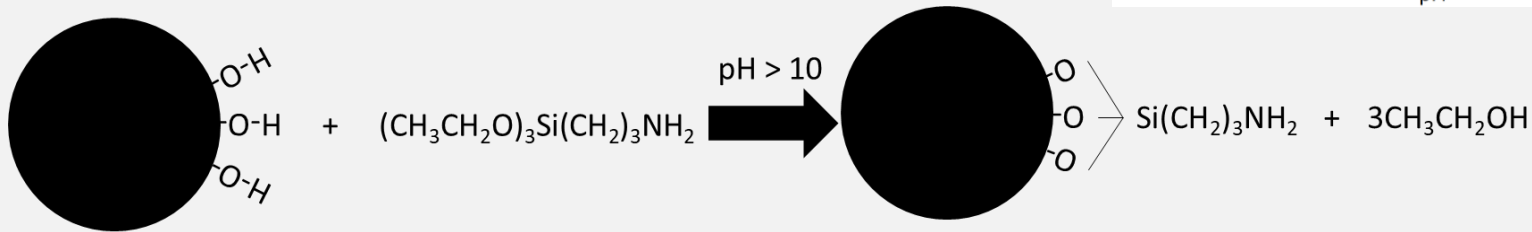
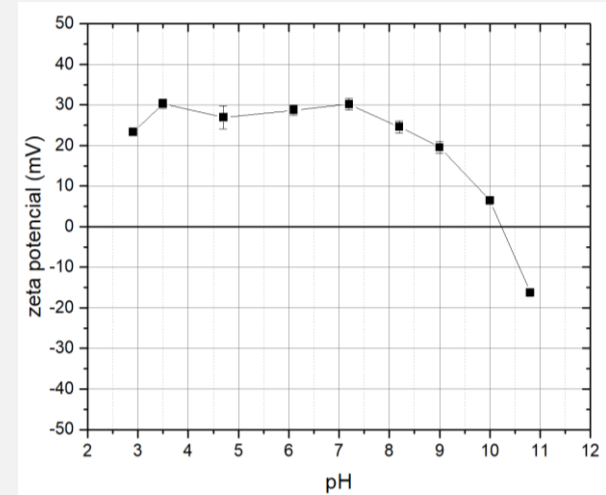
- carboxyl group –COOH
- phosphate group –PO(OH)₂



(3-Aminopropyl)triethoxysilane

Functionalization

- Simple reaction for functionalization
- No leaching from surface – chemically stable
- Prevents excessive agglomeration
- Positive charge at pH 3-4
- Electrostatic interaction with microorganisms

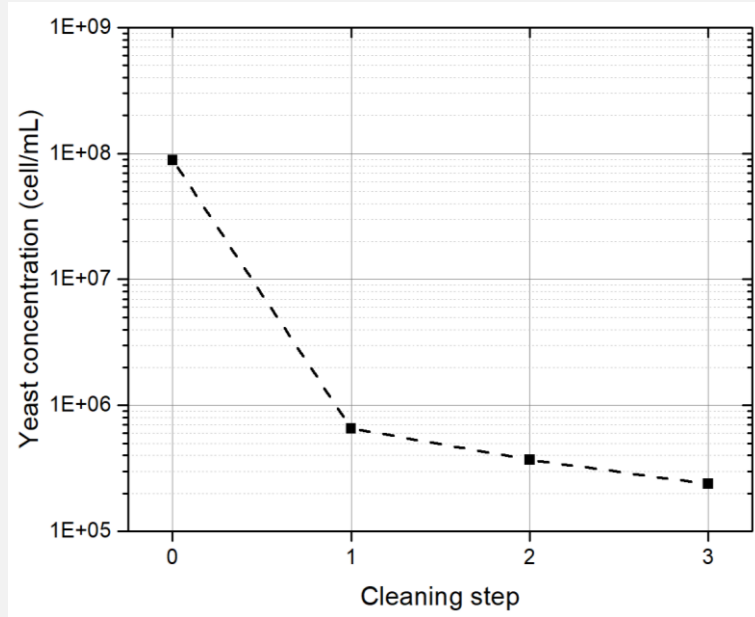


Magnetic separation

- Opening of the bottle, cooled to 7°C or lower
- Mounting the collection chamber on bottle
- Injection of nanoparticles' suspension
- Installation of bottle on the magnetic separator
- Lowering of ring with magnets (several times)
- Closing the collection chamber
- Removing the collection chamber



Result of magnetic separation



After magnetic separation

Before magnetic separation

Turbidity: 1,3 NTU

Effect of magnetic nanoparticles on wine

7 different wines – comparison between treated and untreated wine
7 evaluators (2 enologists)

Wine	Before treatment	After treatment
Rose	3,6	3,0
Zelen 1	3,6	3,4
Chardonnay	3,6	3,5
Rebula	3,0	2,5
Zelen 2	3,8	3,8
Rose sparkling wine	3,2	3,4
White sparkling wine	3,6	3,4

Conclusions

- Yeast and magnetic nanoparticles are bound by electrostatic interaction
- Yeast is removed by magnetic field
- Time is reduced - cca. 3 hours
- Required clarity/turbidity is achieved
- No significant influence on the wine

Acknowledgment

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REPUBLIKA SLOVENIJA
**MINISTRSTVO ZA GOSPODARSKI
RAZVOJ IN TEHNOLOGIJO**

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Thank you for your attention