

UPORABA MAGNETNIH NANODELCEV ZA SEPARACIJO KVASOVK *Saccharomyces bayanus* V ALKOHOLNI FERMENTACIJI PENEČIH VIN

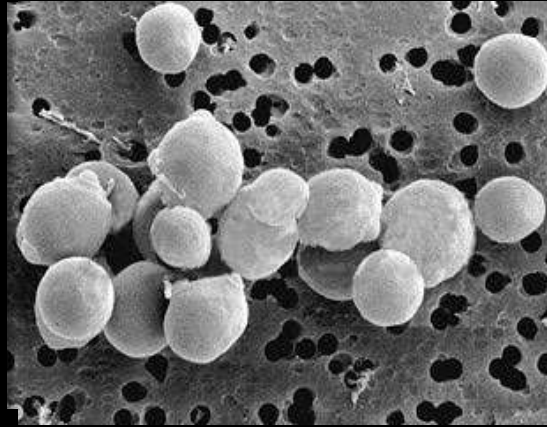
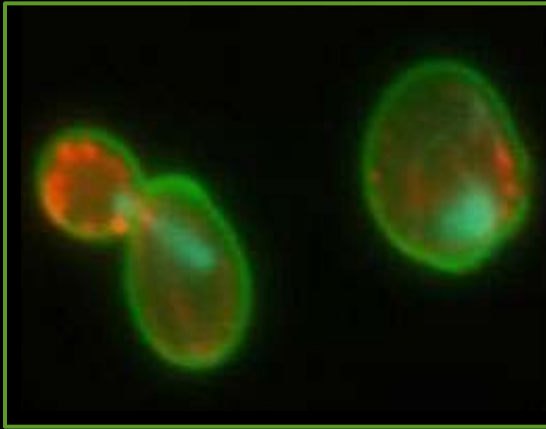


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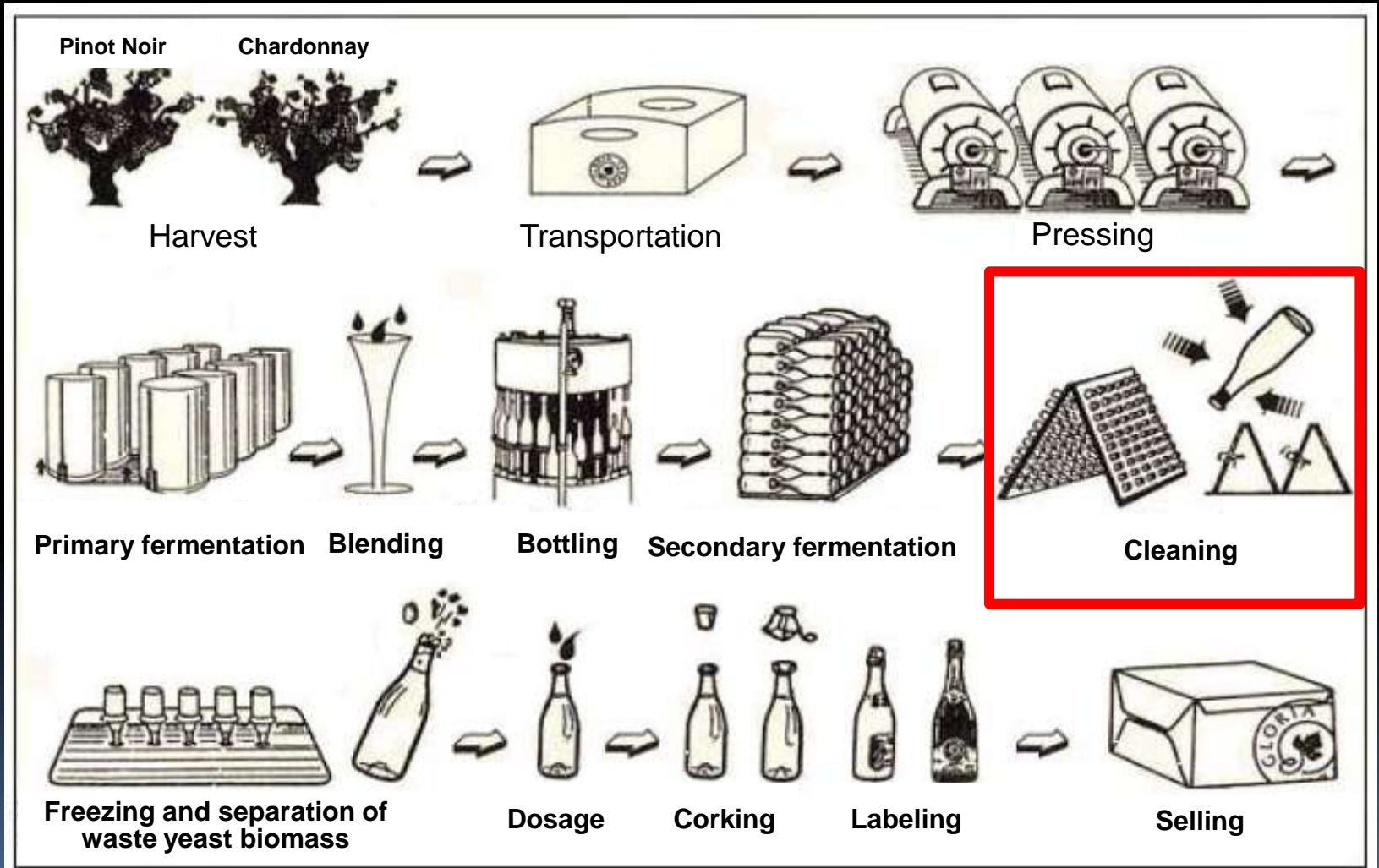
The Aim



Magnetization of wine yeast
Saccharomyces bayanus living cells
and fast separation of exhausted biomass, after the
secondary fermentation in wine bottles,
in external magnetic field gradient

Schematic overview of secondary wine fermentation in the bottles

Methode Champenoise Clasique

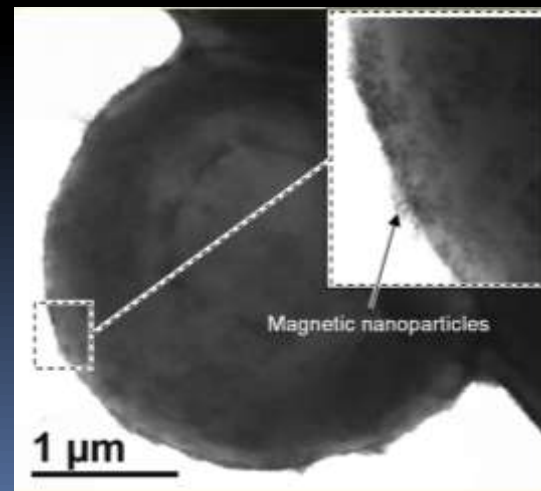
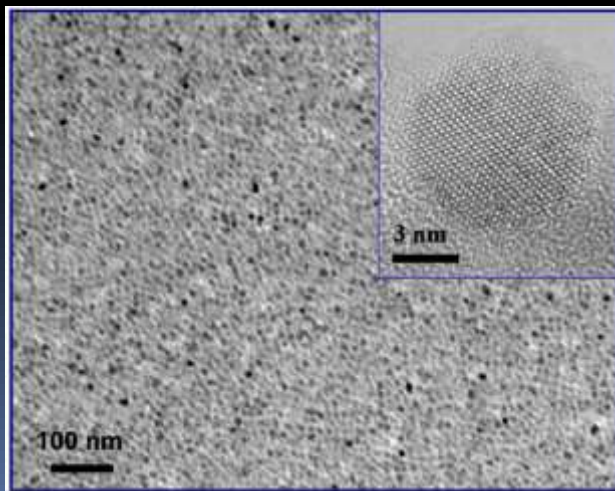


Magnetic separation

Adsorption of superparamagnetic nanoparticles on the yeast cells + magnetic separation.

Superparamagnetic nanoparticles of ferro oxide – *maghemite*,
size approx. 13 nm .

Superparamagnetism occurs in ferrimagnetic particles when their size is reduced below a certain limit (below approximately 15 nm for maghemite) and thermal excitation induces rapid fluctuations of the particle's magnetic moment.



MATERIAL

□ yeast

Champagne yeast *Saccharomyces bayanus*, 18-2627,
Epernay, France

□ substrate

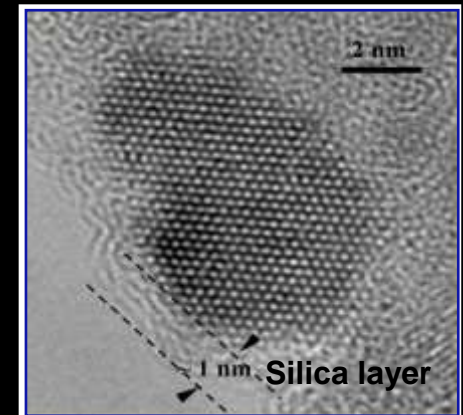
Sauvignonasse grape must , Goriska Brda

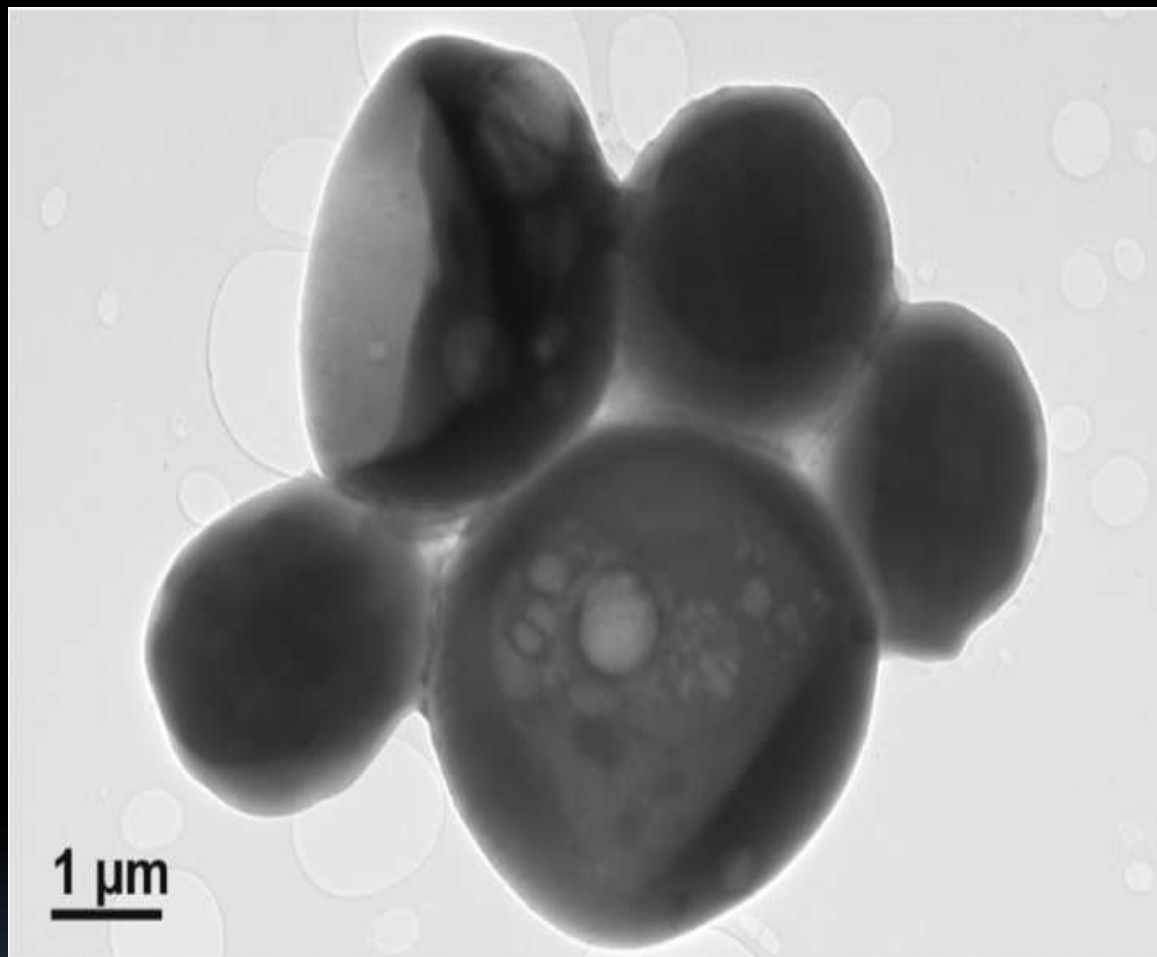
□ magnetnetic nanoparticles

Superparamagnetic nanoparticles of maghemite, size 13 nm,
covered with

MD-Si-APMS : 2 nm layer of silica (SiO_2) and grafted with
aminopropil silane - positive surface charge

MD-CA : adsorbed citric acid - negative surface charge





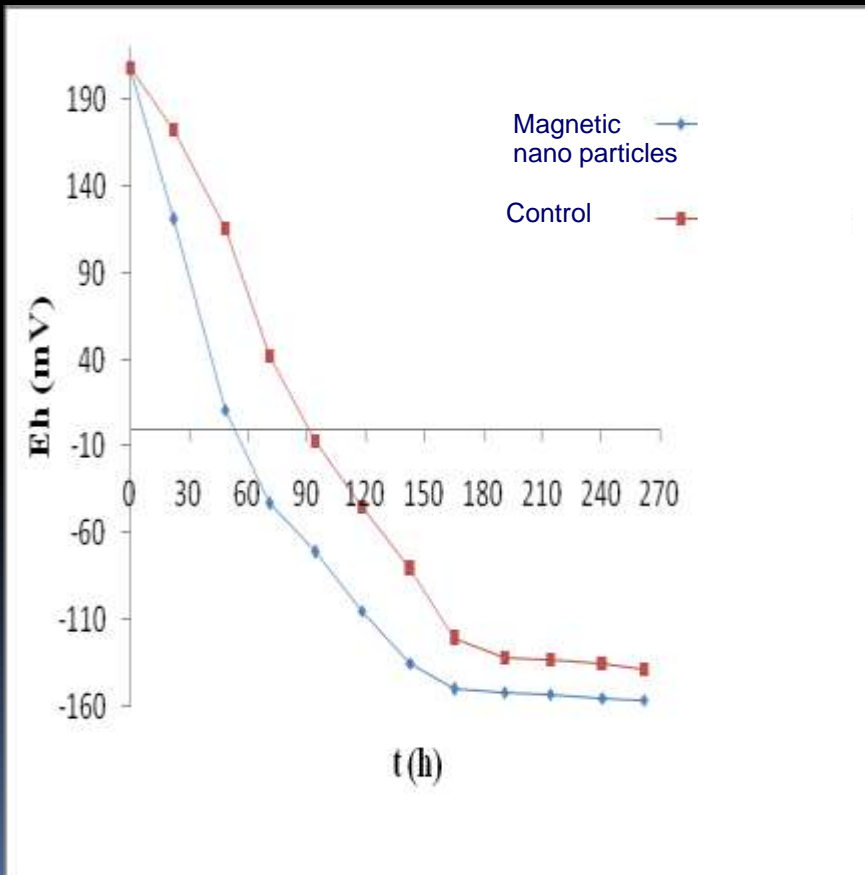
Saccharomyces cerevisiae with magnetic nanoparticles on the surface of the cell walls



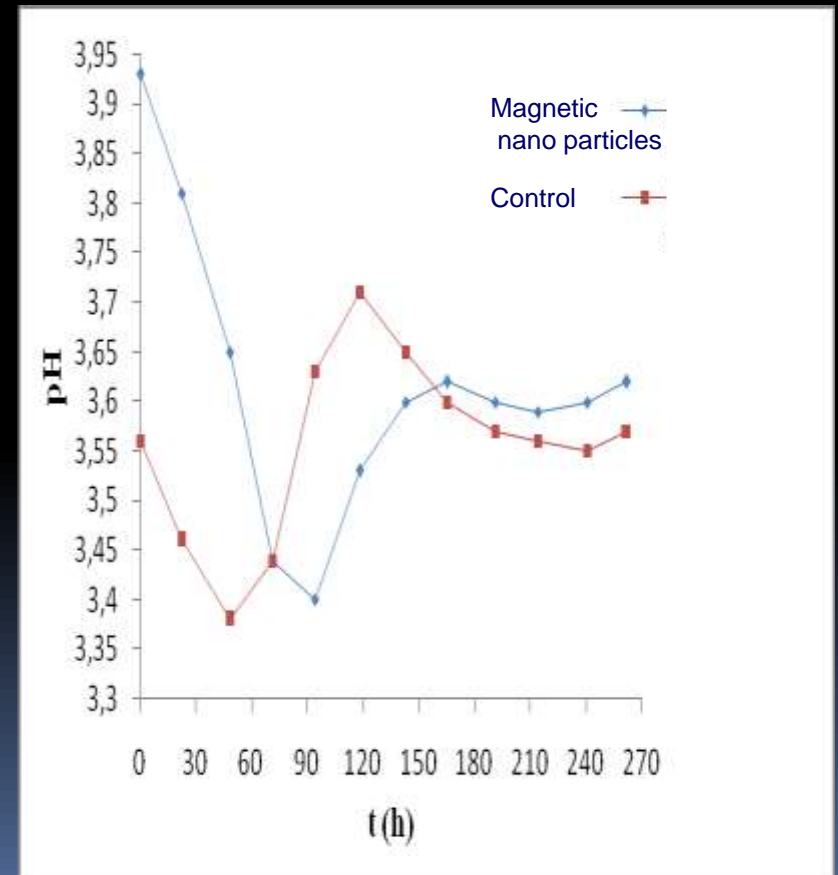
Separation at application of different nanoparticles
MD-Si-APMS *left* ; MD-CA *right*

Kinetics of alcohol fermentation

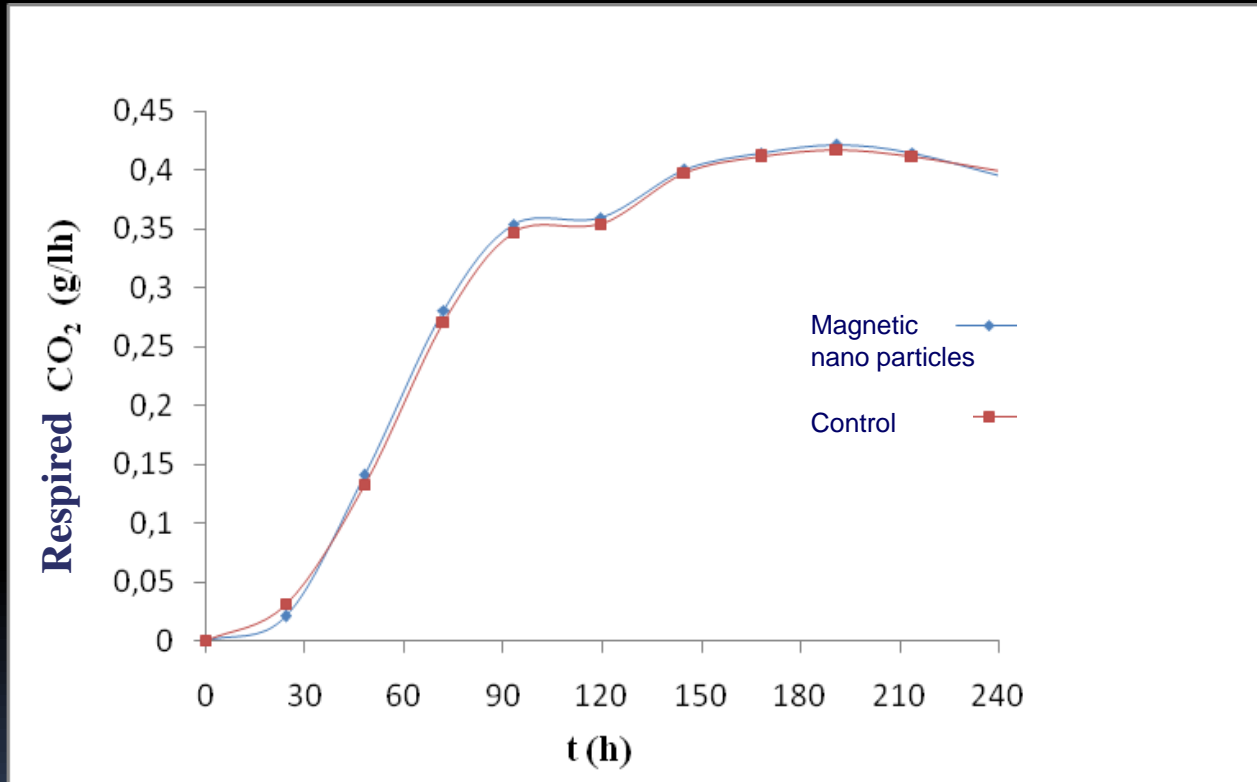
Redox potential course



pH course



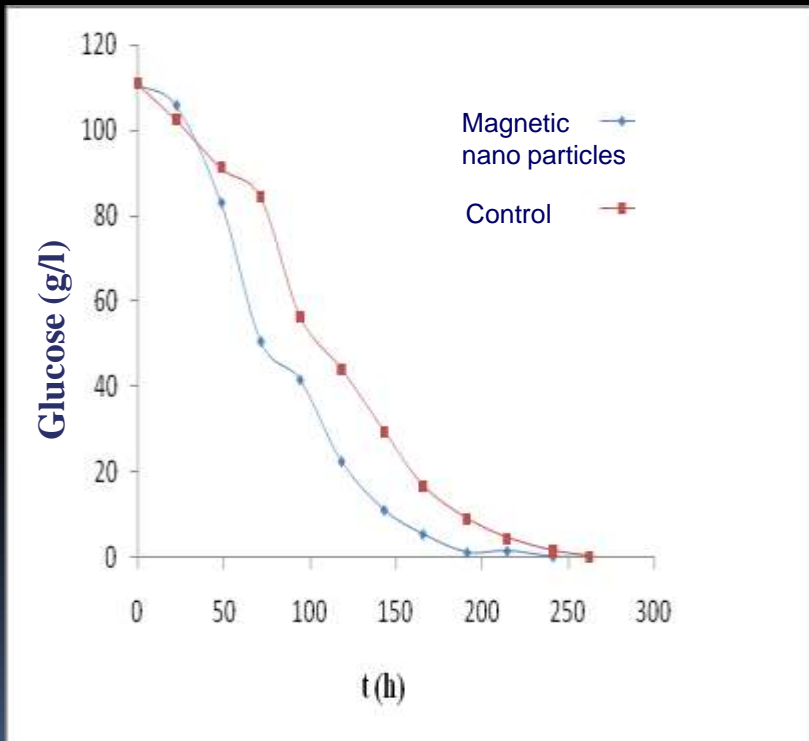
Respiration of CO₂



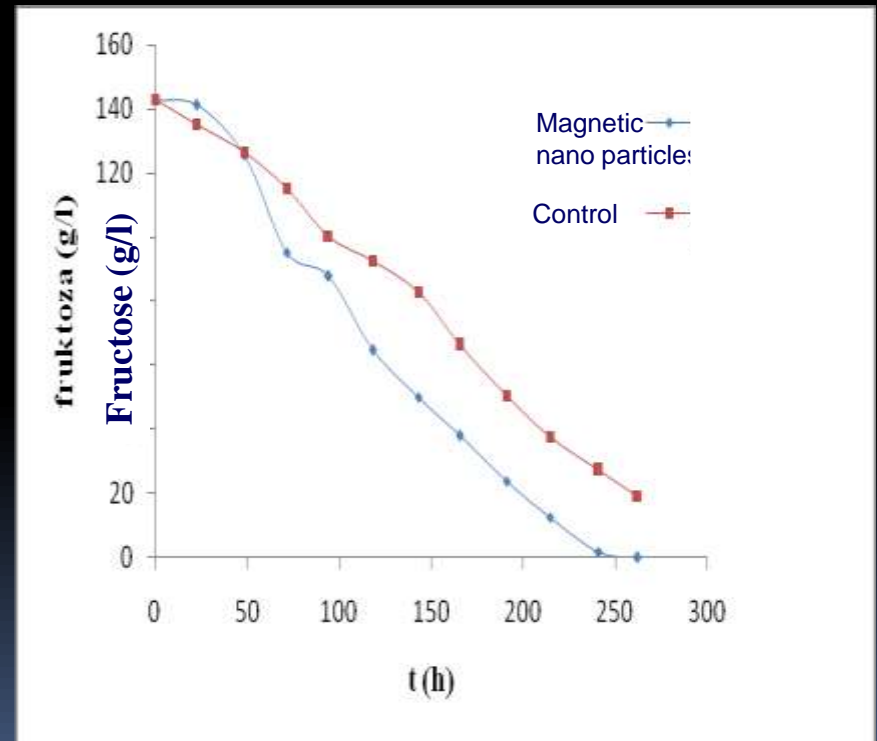
Respiration course of CO₂ in alcohol fermentation

Reductive sugars consumption

☐ glucose

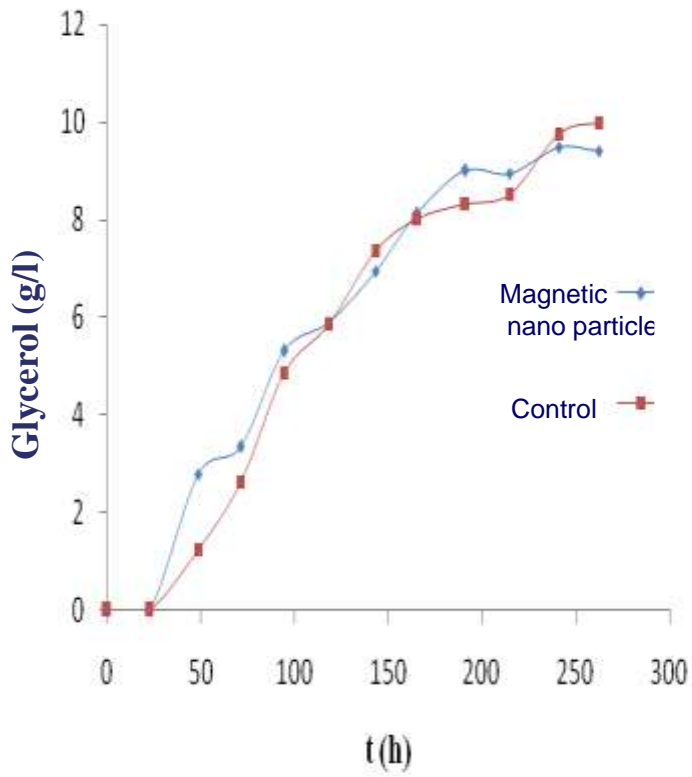


☐ fructose

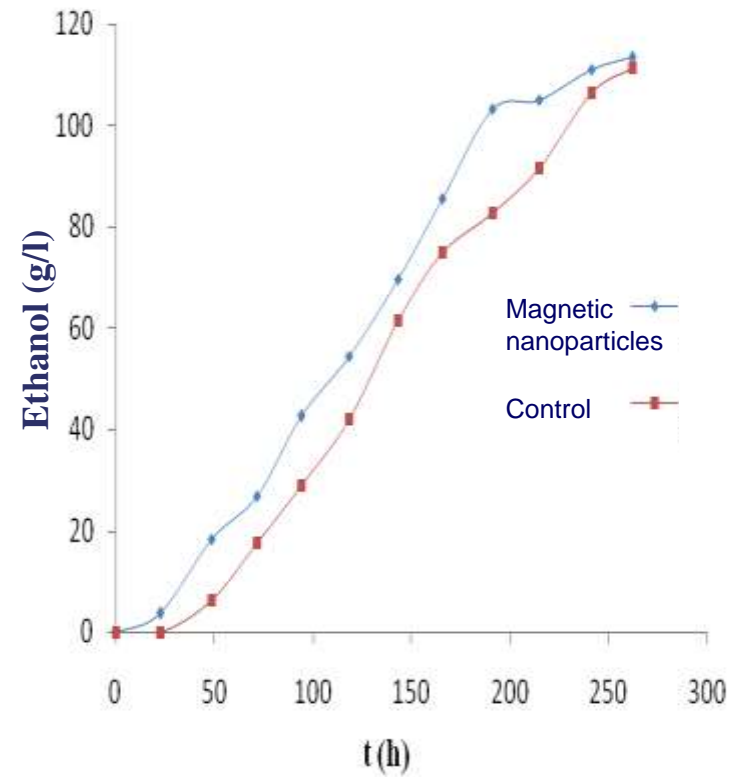


Metabolic products dynamics

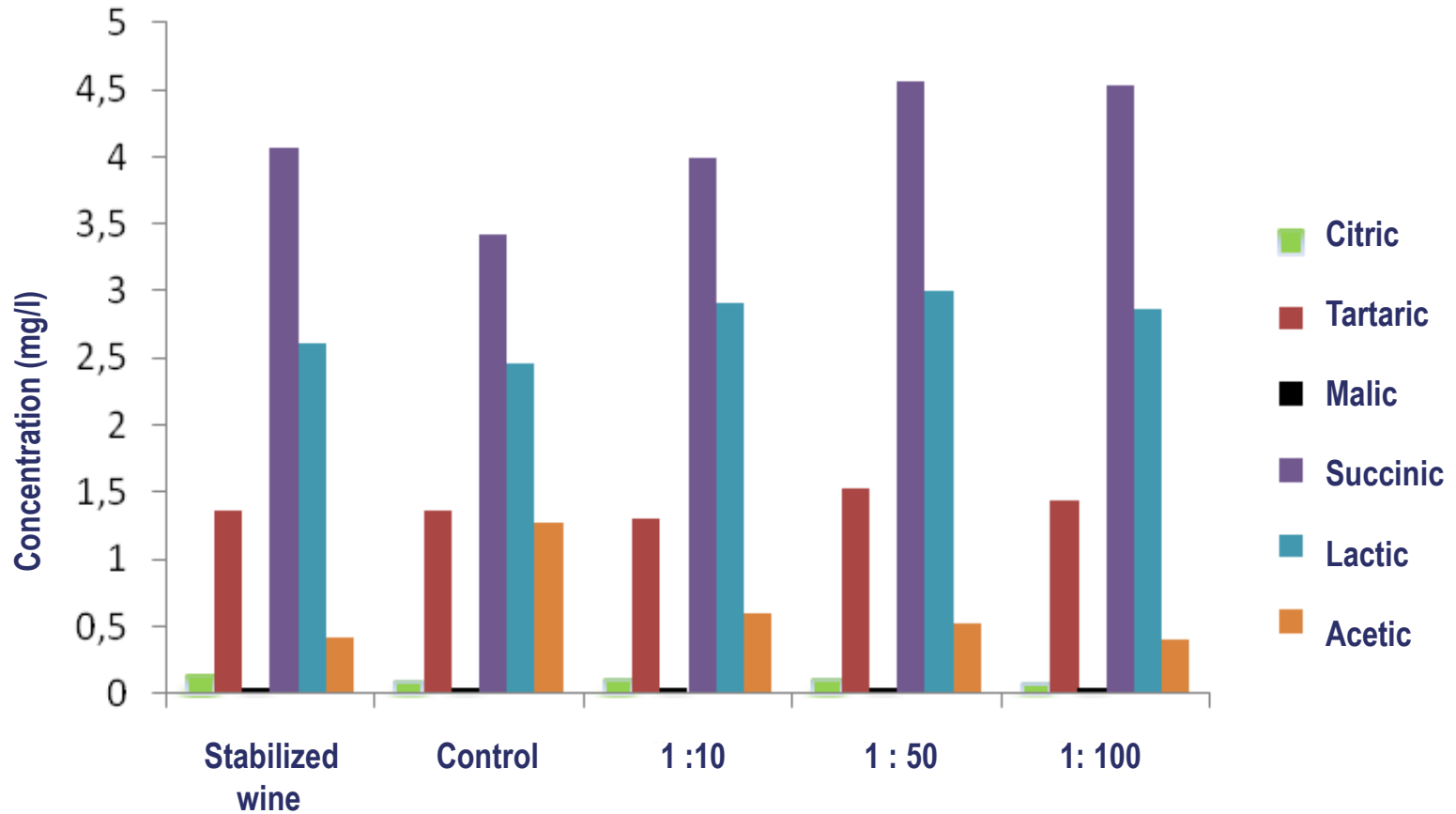
glycerol



ethanol

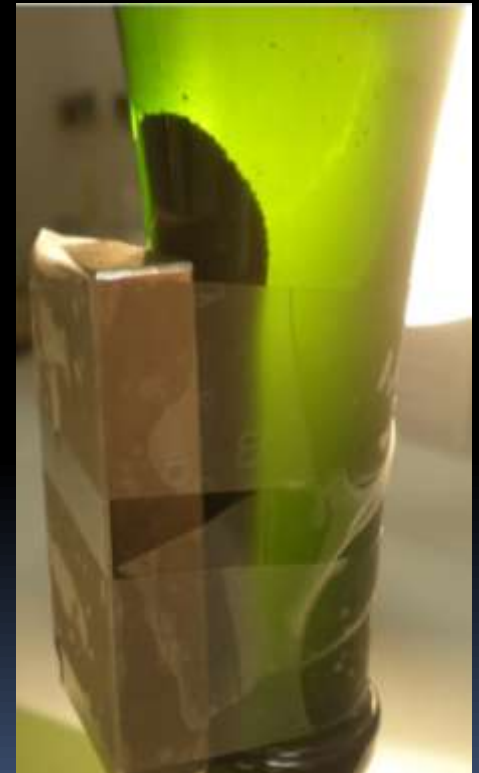


Organic acids



Separation

	Magnetic field separation	Without
Sample	(min)	(min)
A	5	30
B	13	95
C	16	120
Control	/	240
Without	/	60 days



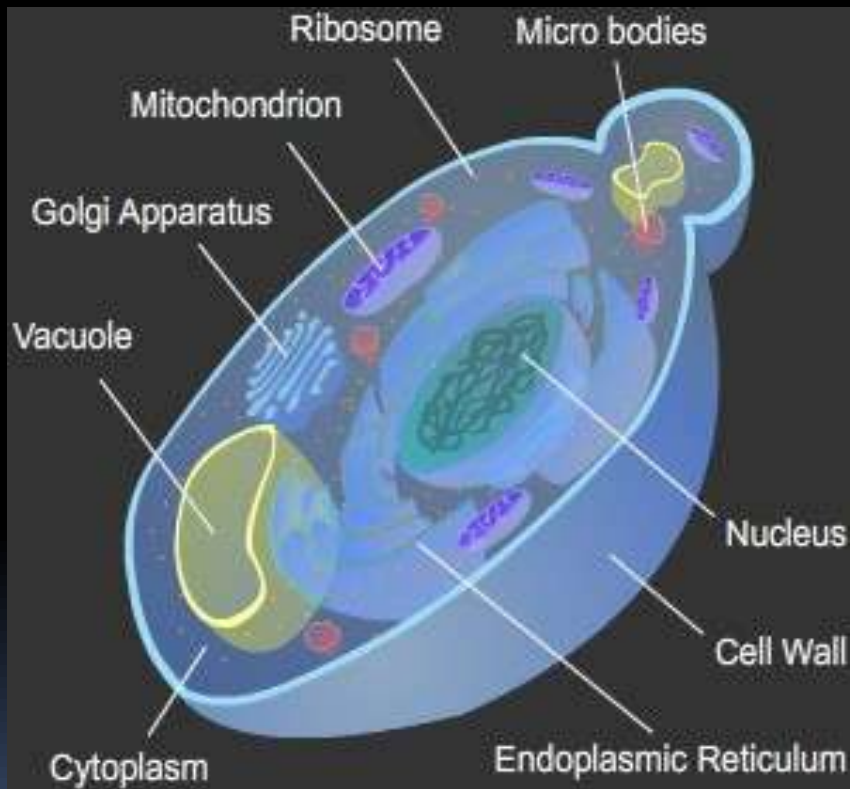
Pressure

Sample	Parallel 1	Parallel 2
A	5,30 bar	5,25 bar
B	5,25 bar	5,20 bar
C	5,30 bar	5,30 bar

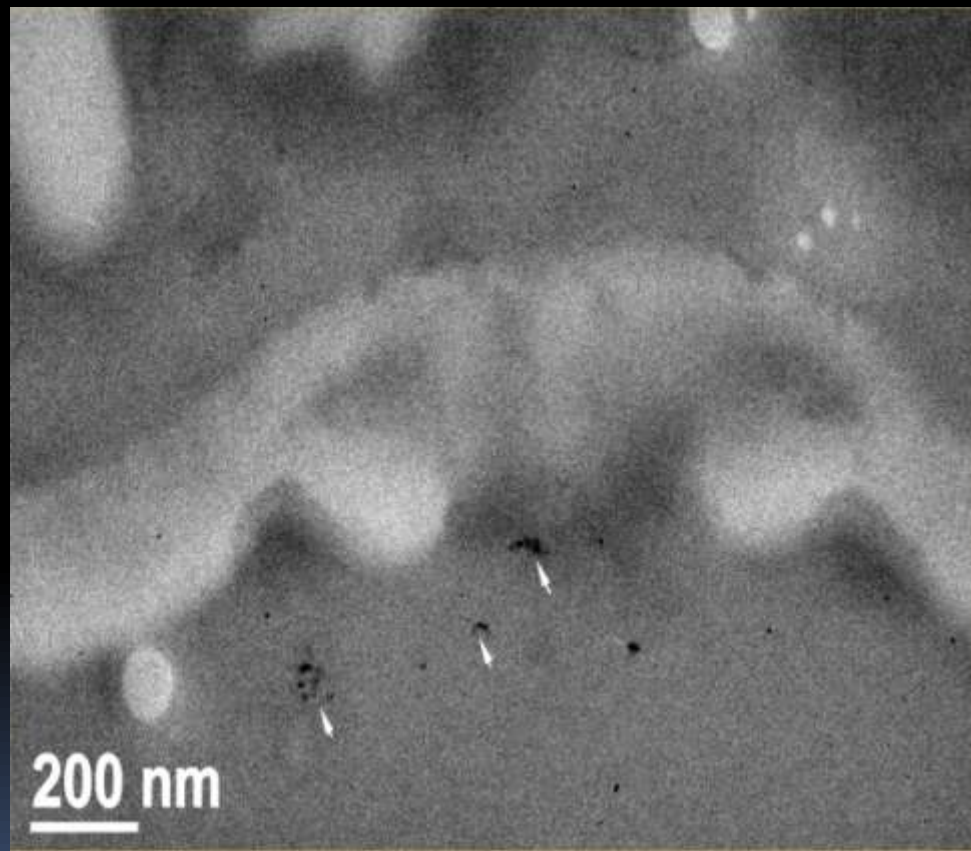
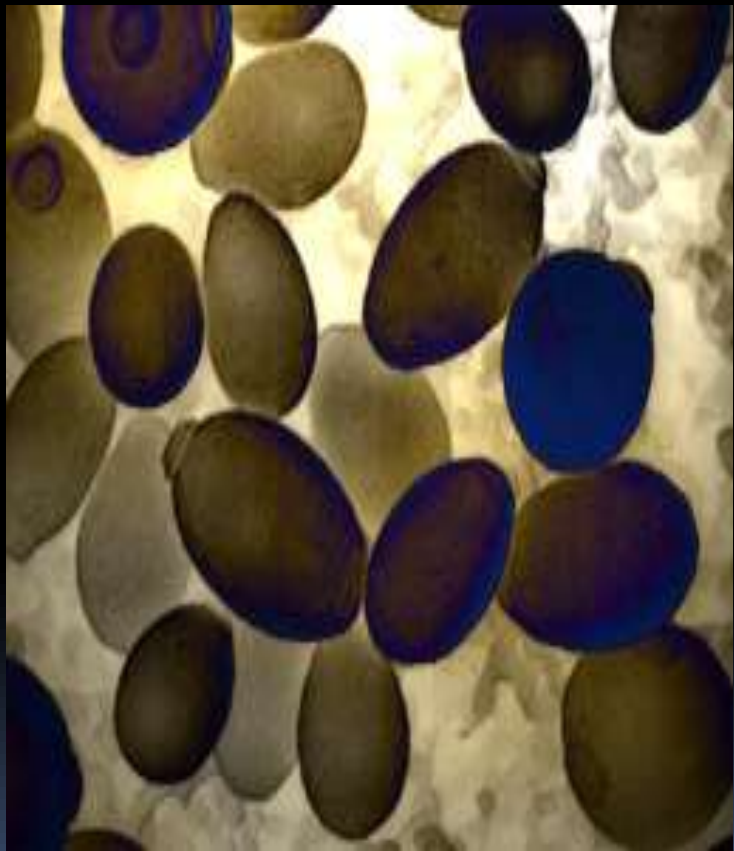
Control sparkling wine - without magnetized yeast cells
P = 5,30 bar



Saccharomyces bayanus and adhesion of magnetic nanoparticles



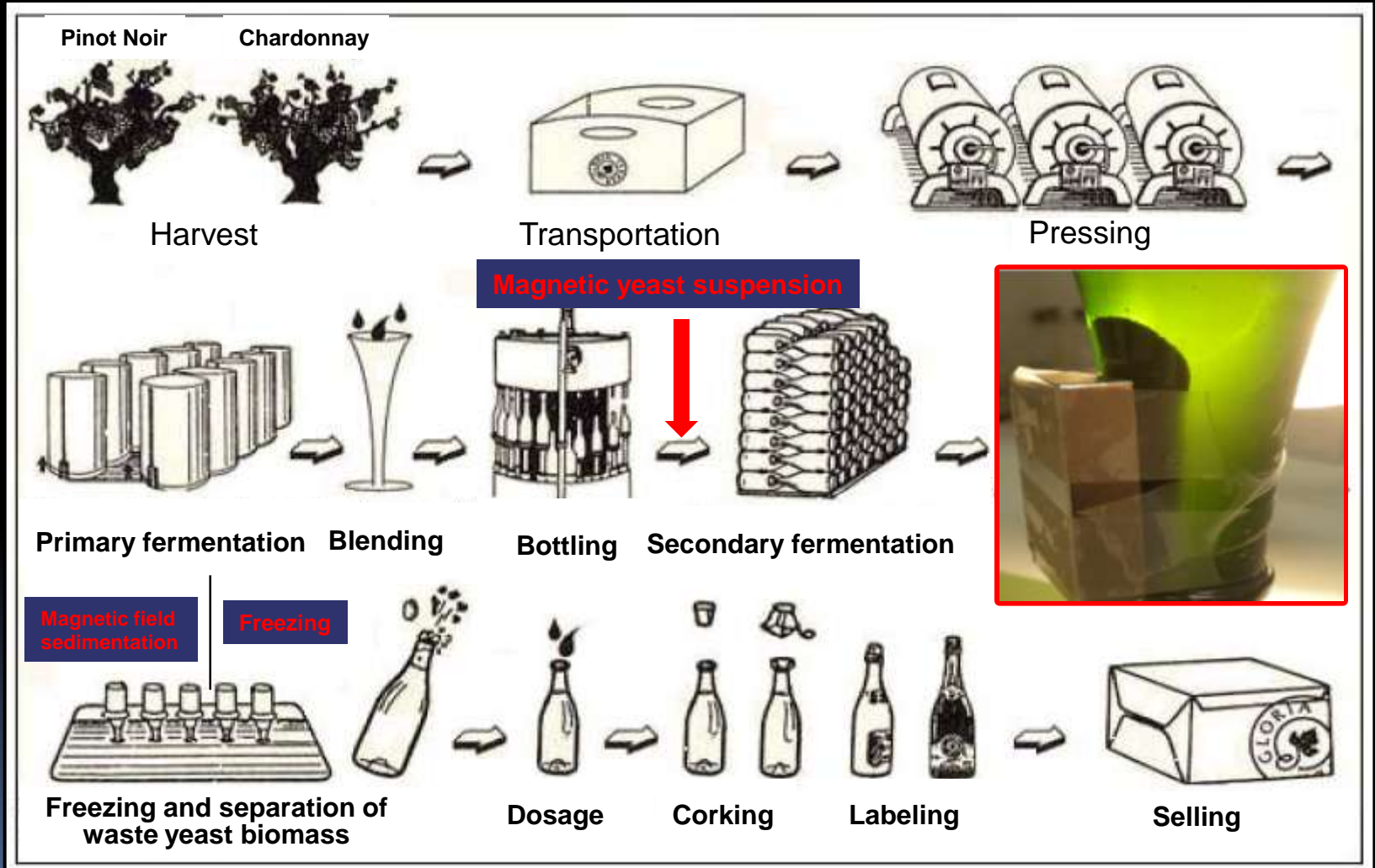
Saccharomyces bayanus and adhesion of magnetic nanoparticles



CONCLUSIONS

- ❑ Magnetic nanoparticles on surface of yeast cell membranes do not penetrate in inside of yeast cell.
- ❑ With duplication also the daughter cells contain magnetic nano particles.
- ❑ Magnetic nanoparticles on surface of yeast cell membranes accelerate fermentation process kinetics and metabolic activity.
- ❑ The rate of reductive sugar consumption is faster.
- ❑ Presence of magnetic nanoparticles does not influence on fermentation pH
- ❑ Magnetic nanoparticles do not influence on yeast cells respiration
- ❑ The carbon dioxide pressure in control and in bottles with applied magnetic yeast cells is the same
- ❑ Magnetic nanoparticles do not influence on final ethanol and glycerol concentration
- ❑ Non significant changes in on organic acid biosynthesis was detected, slightly increased lactic acid and slightly decreased acetic acid were detected.
- ❑ Optimal ratio between magnetic nanopartices and wine yeast is 1:50
- ❑ Magnetic nanoparticles do not influence on do not influence on sensorial analyses of sparkling wine
- ❑ Exess magnetic nanoparticles that woud stay in the sparkling wine would in the glass balance as the nucleus the bubbling.
- ❑ Exess magnetic nanoparticles would solute in hydrochloric acid the stomach
- ❑ Separation of waste yeast biomass in magnetic field is 30 minutes

Innovations in Methode Champenoise Clasique



Ferric ion analysis

Sample	Fe (mg/l)
Without magnetic yeast	0.40
Fermentation with magnetic yeast	0.60