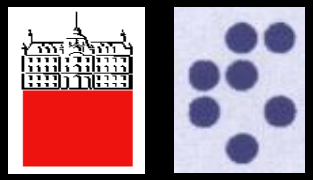
NEW METHOD FOR FAST SEPARATION OF MAGNETIZED YEAST *Saccharomyces cerevisiae* FROM SPARKLING WINE



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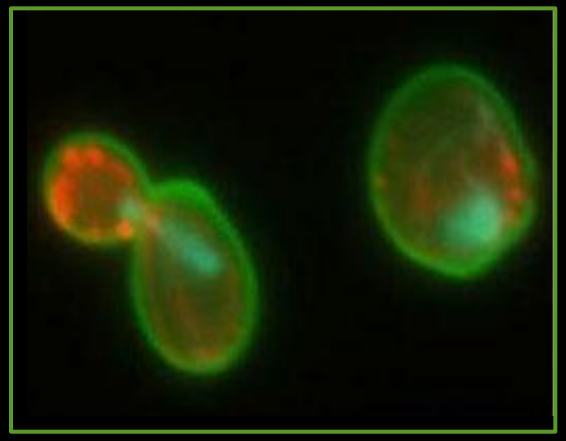
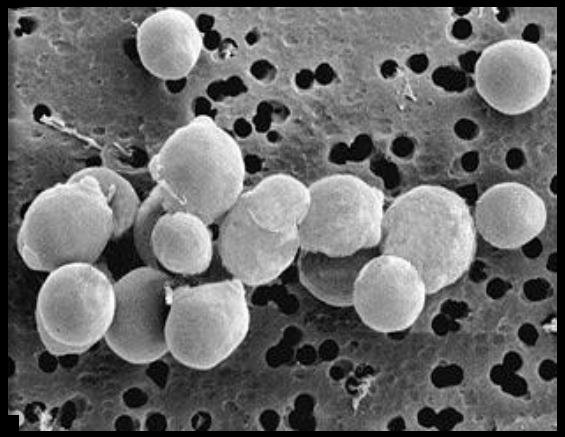
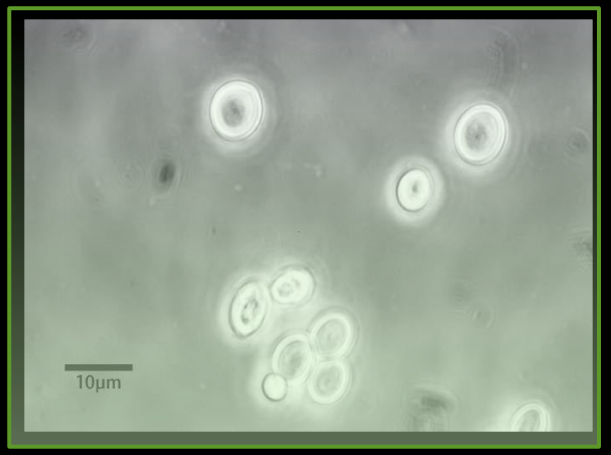
The Aim



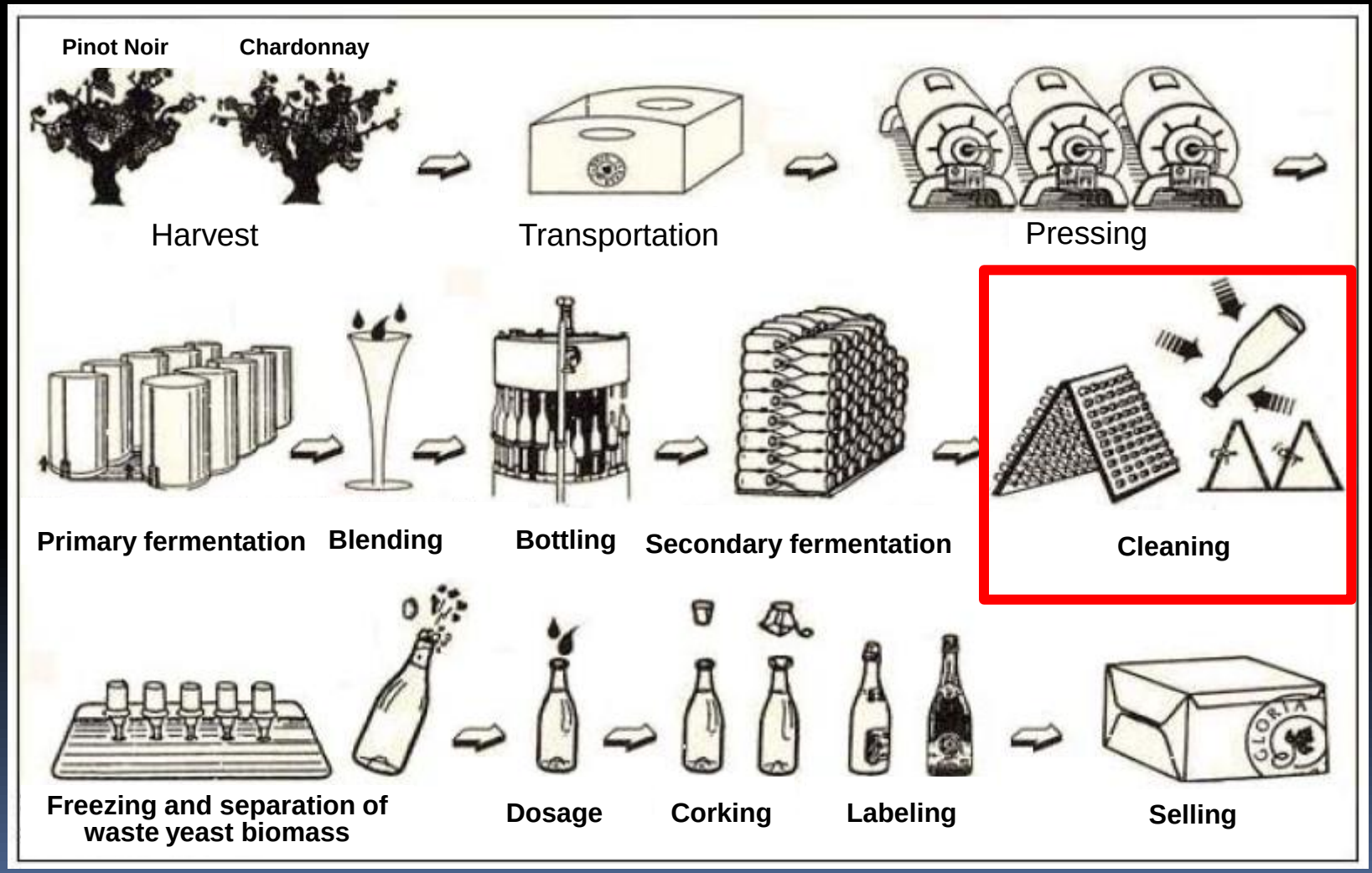




Magnetization of wine yeast
Saccharomyces bayanus living cells
and fast separation of exhausted biomass, after the
secondary fermentation in wine bottles,
in external magnetic field gradient

Shematic overview of secondary wine fermentation in the bottles

Methode Champenoise Clasique

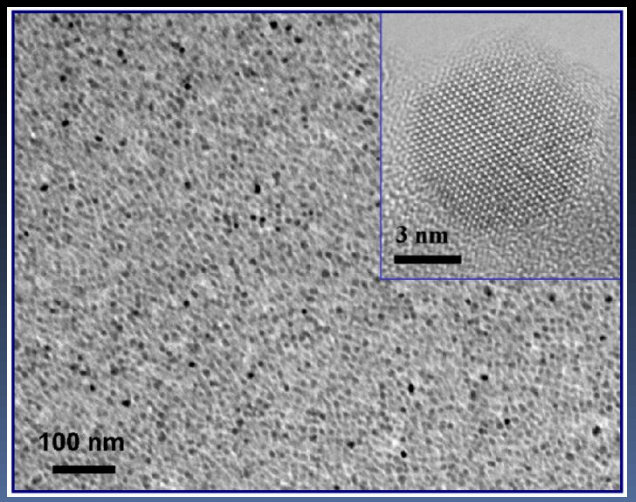


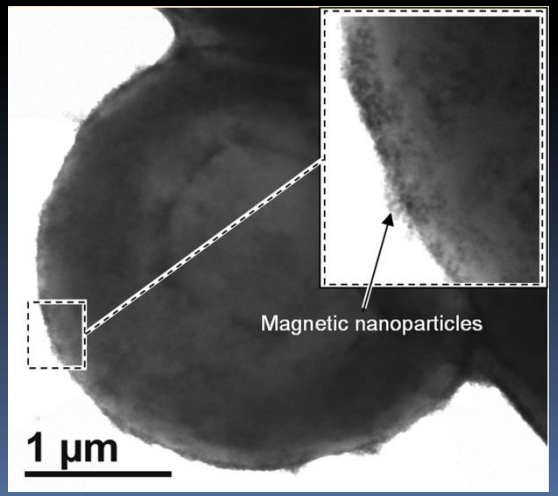
Magnetic separation

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

Superpramagnetic nanoparticles of ferro oxide – *maghemit, 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

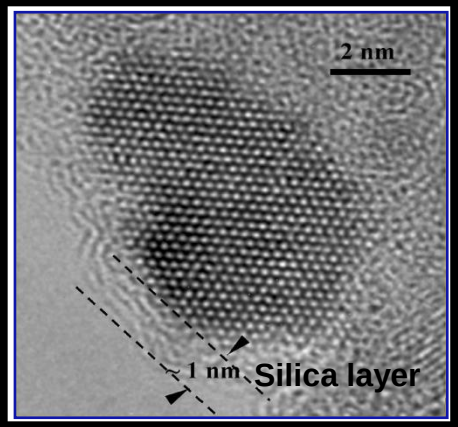
- **yeast**

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

- **substrate**

  Sauvignonasse grape must , Goriska Brda

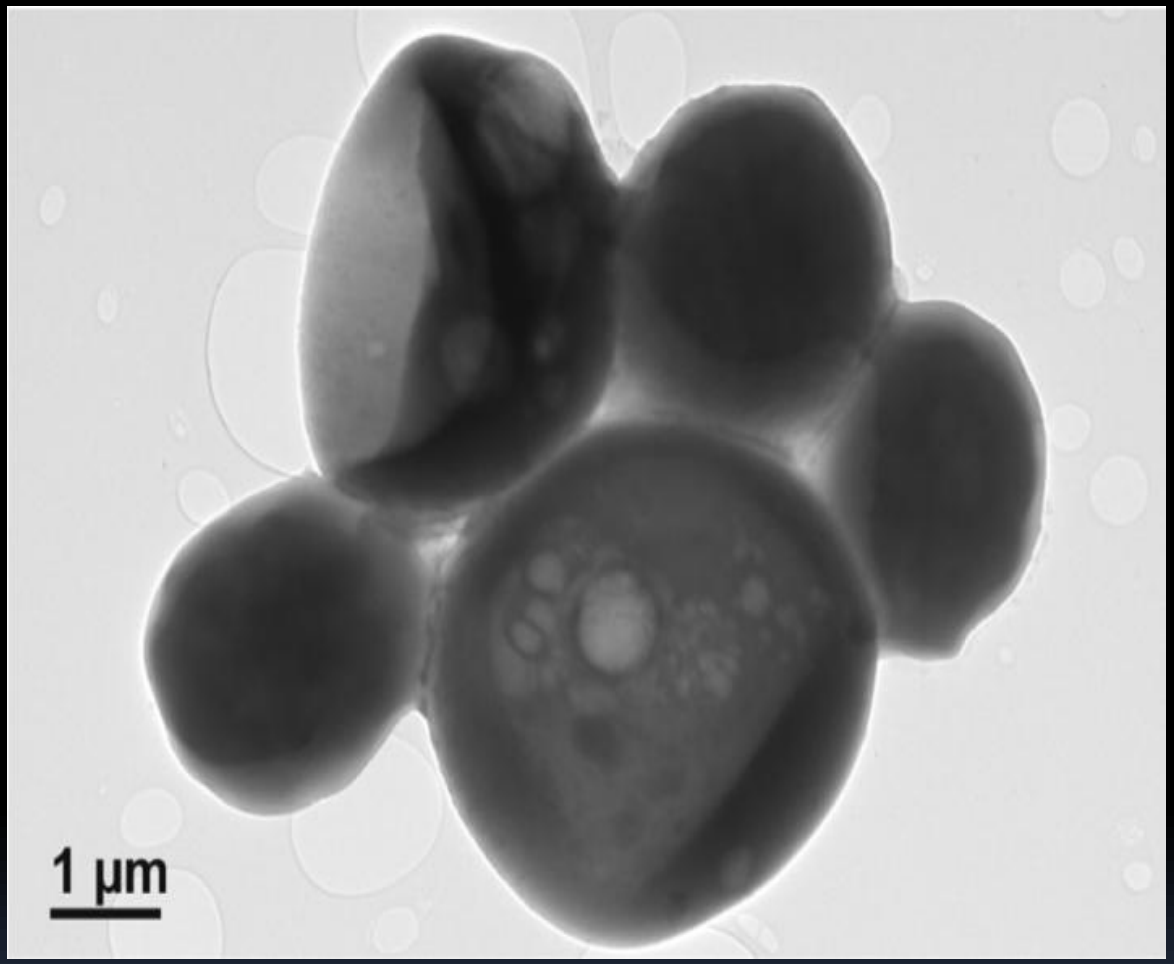
- **magnetnetic nanoparticles**



  Superparamagnetic nanoparticles of maghemit, size13 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

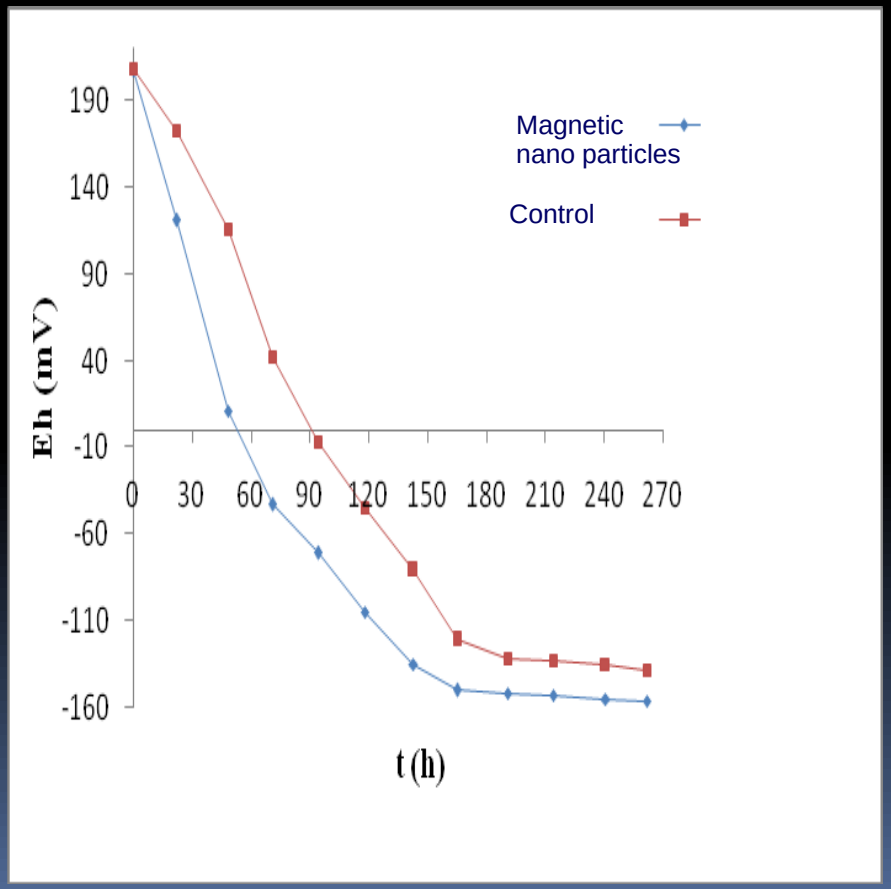


Saccharomyces cerevisiae with magnetic nanoparticles on the surface of the cell walls

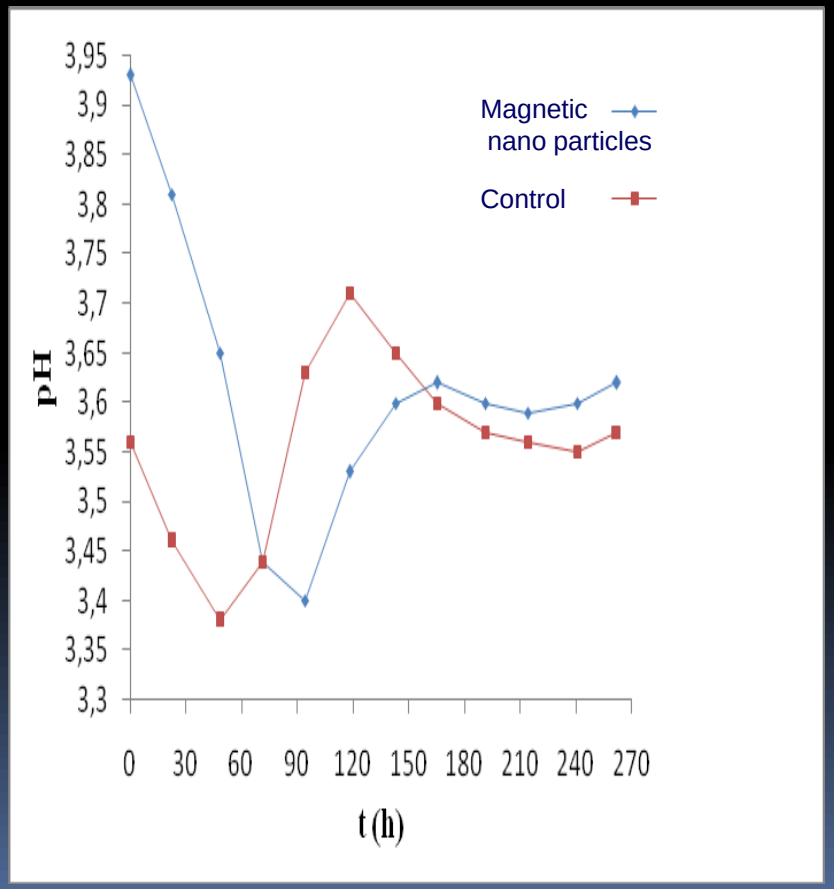
Separation at application of different nanoparticles MD-Si-APMS *left* ; MD-CA *right*

Kinetics of alcohol fermentation

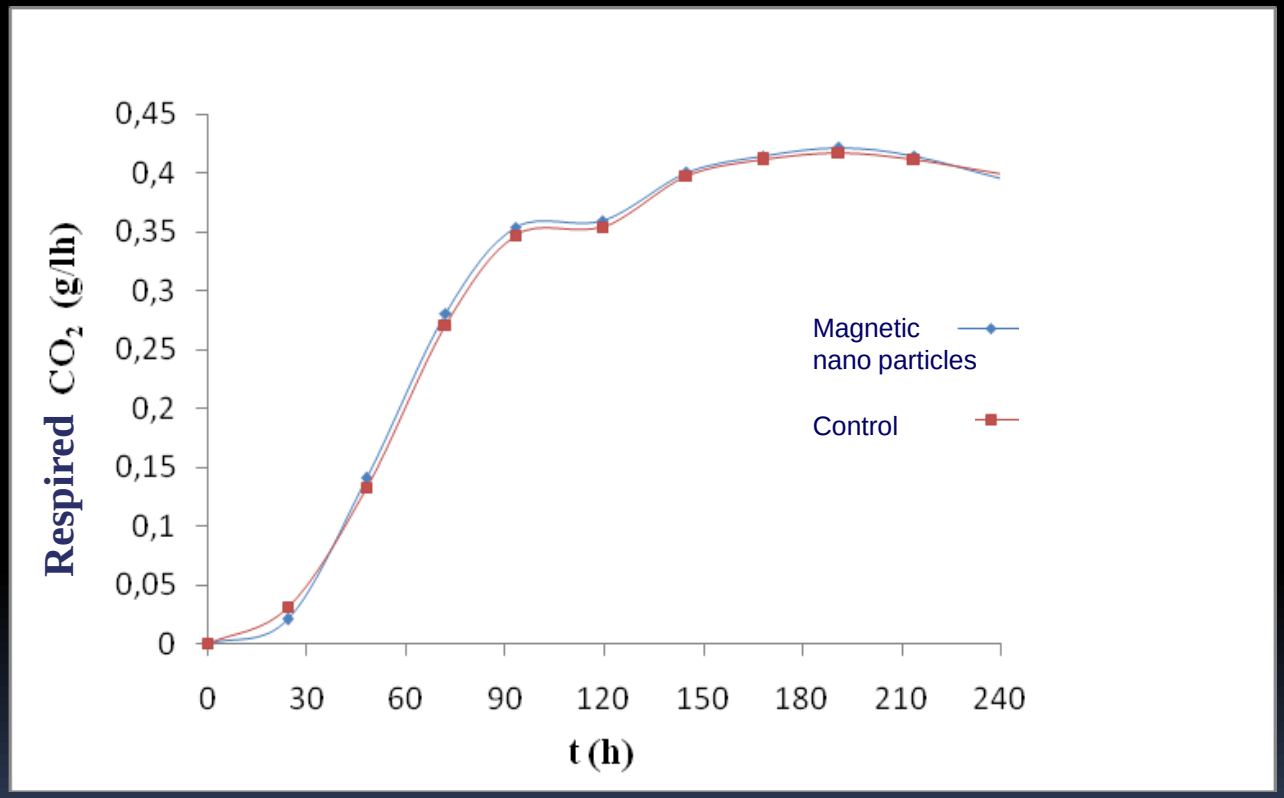
- **Redox potential course**



- **pH course**



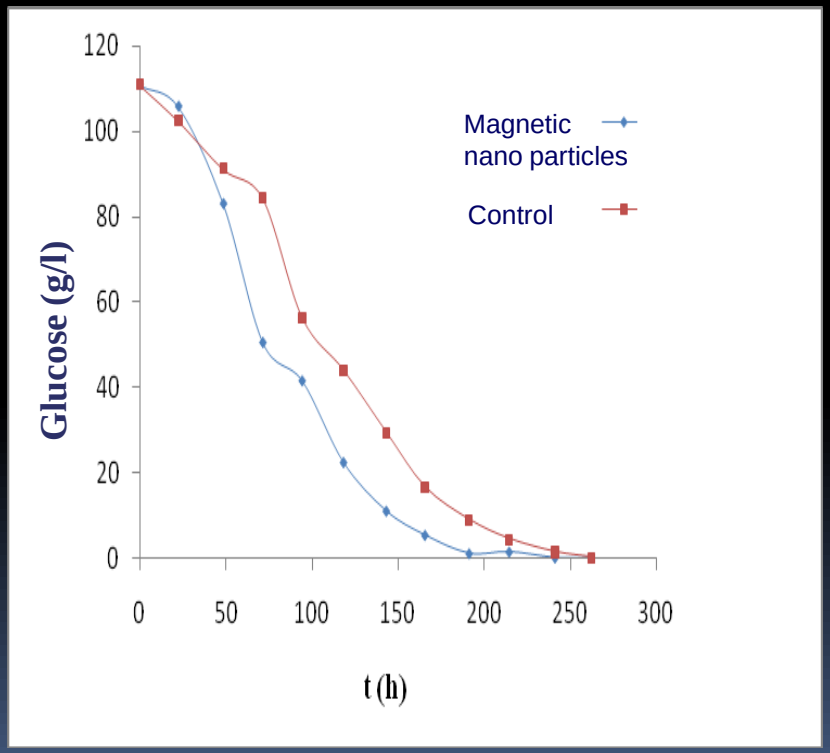
Respiration of CO_2



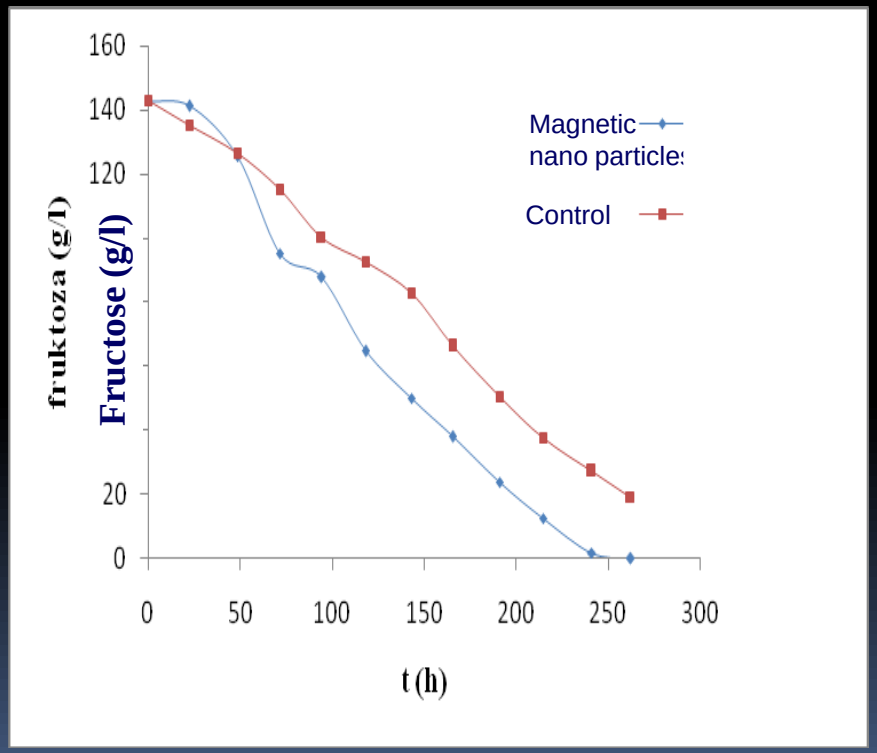
Respiration course of CO_2 in alcohol fermentation

Reductive sugars consumtion

- **glucose**

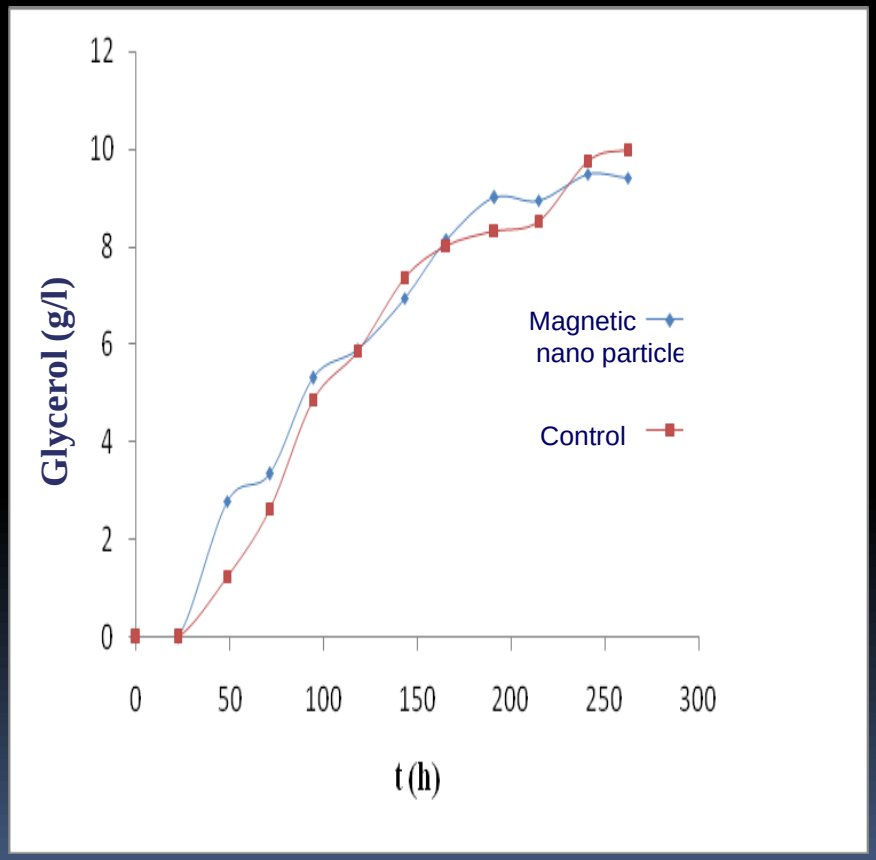


- **fructose**

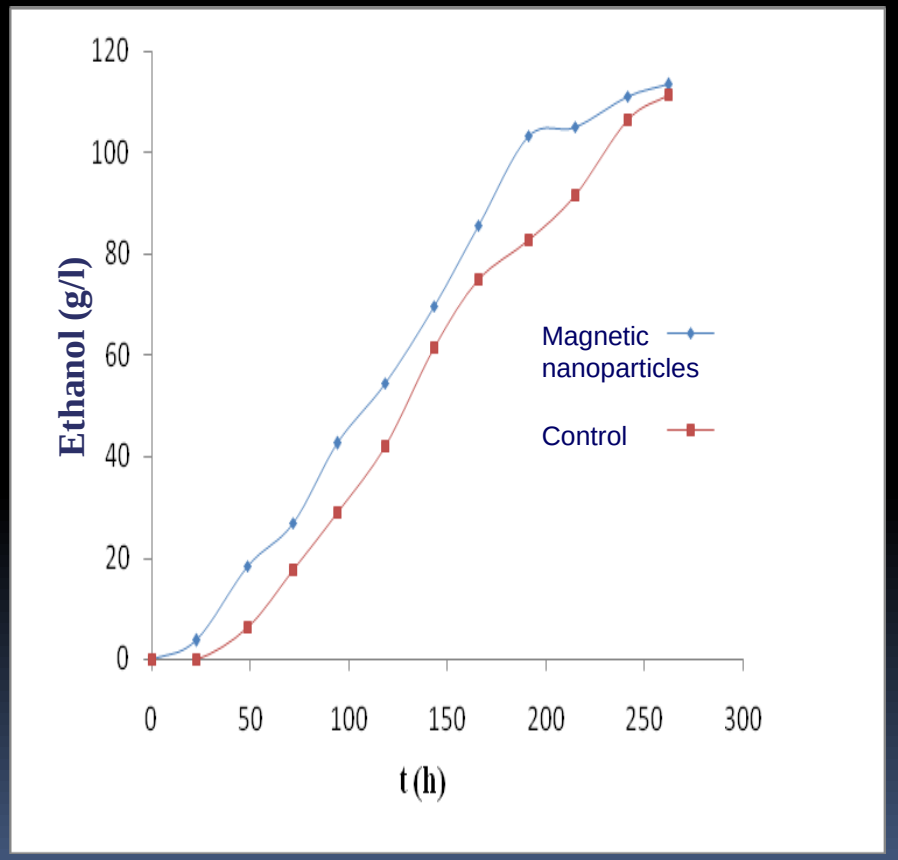


Metabolic products dynamics

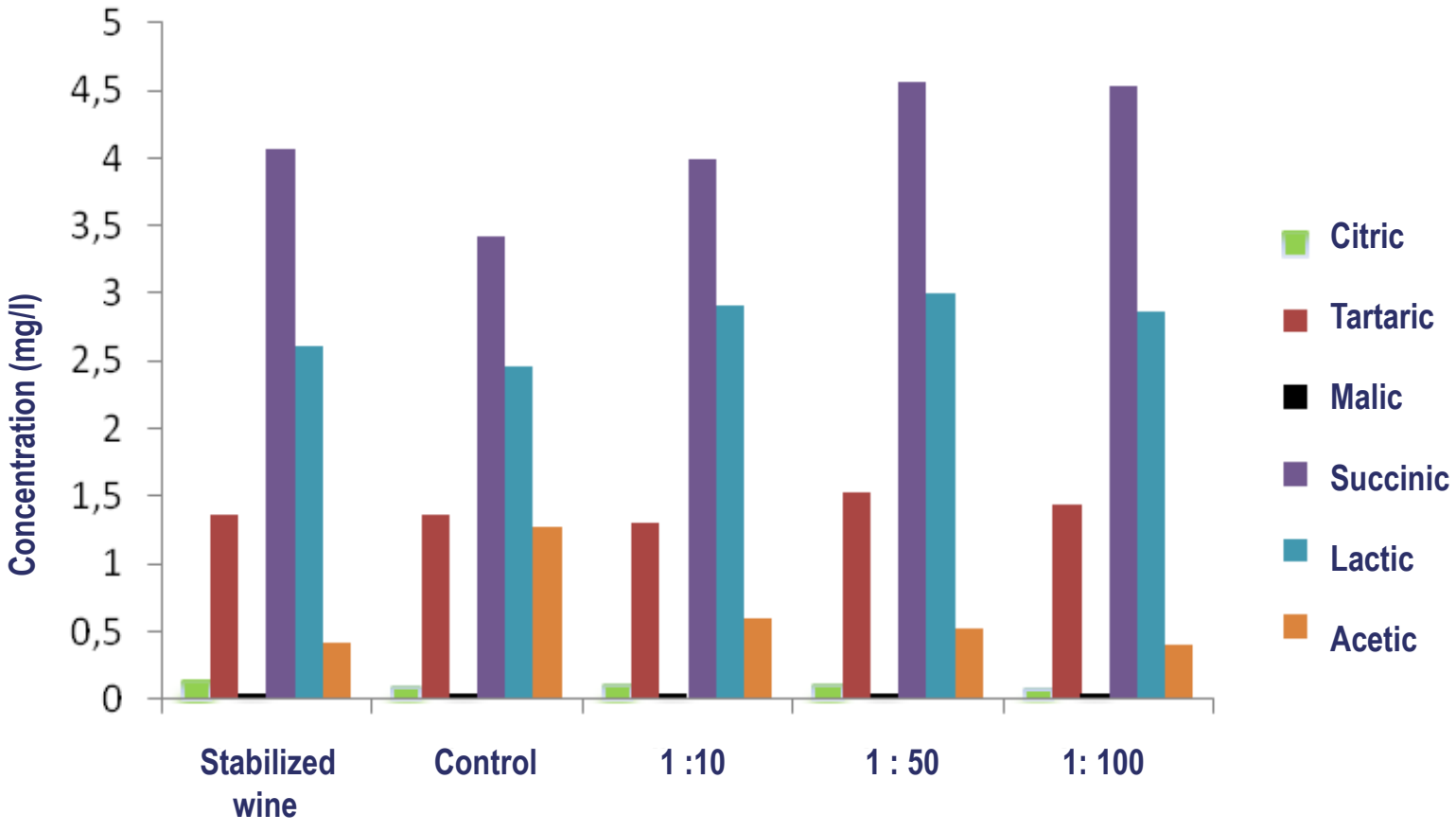
- **glycerol**



- **ethanol**

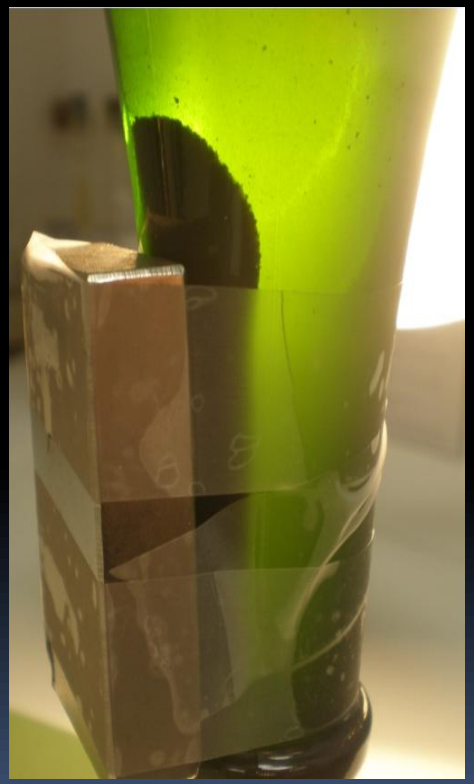


Organic acids



Separatation

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

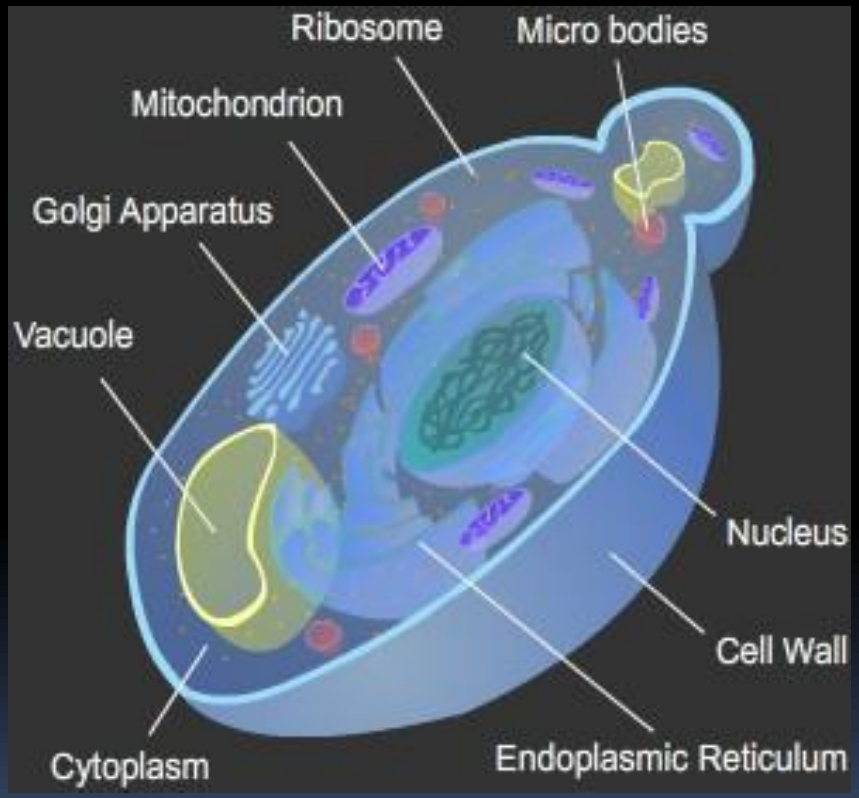


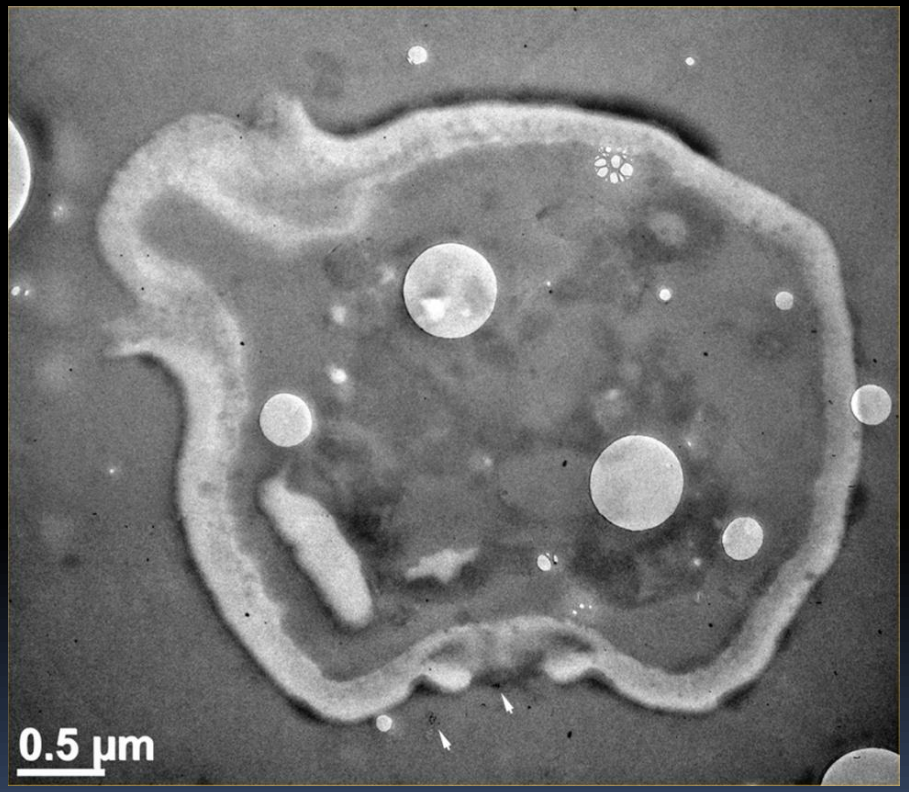
Pressure

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

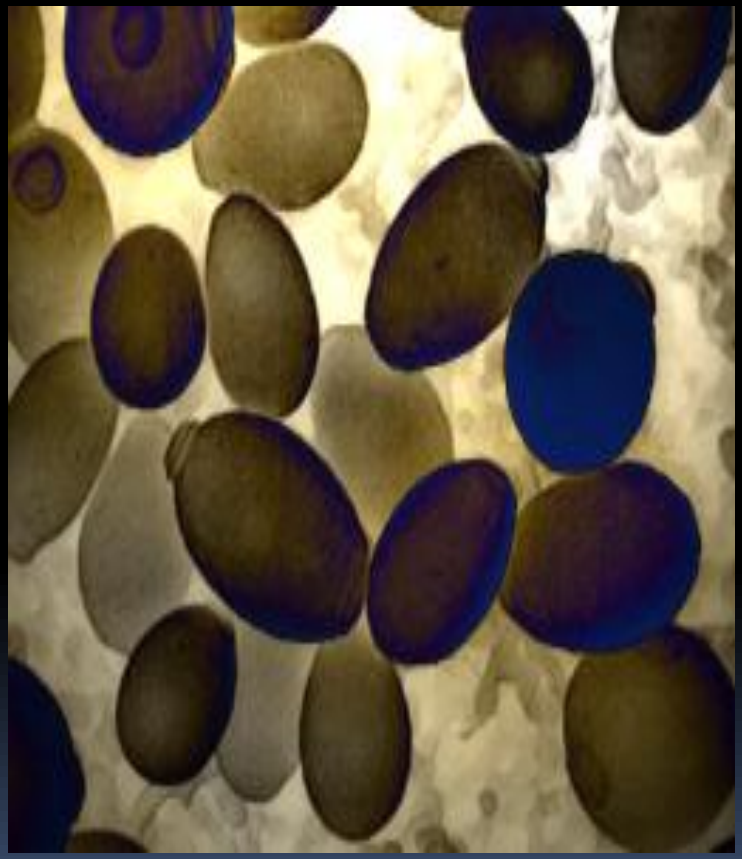
Control sparkling wine - without magnetized yeast cells
P = 5,30 bar

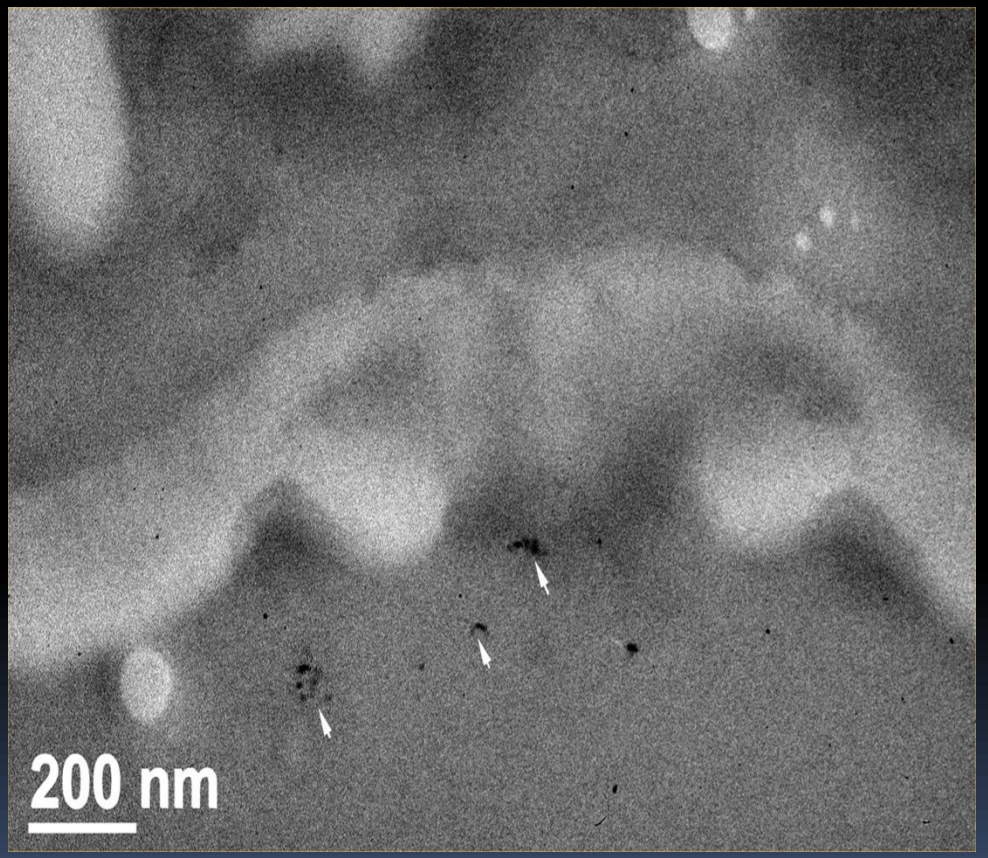
Saccharomyces bayanus and adhesion of magnetic nanoparticles





Saccharomyces bayanus and adhesion of magnetic nanoparticles

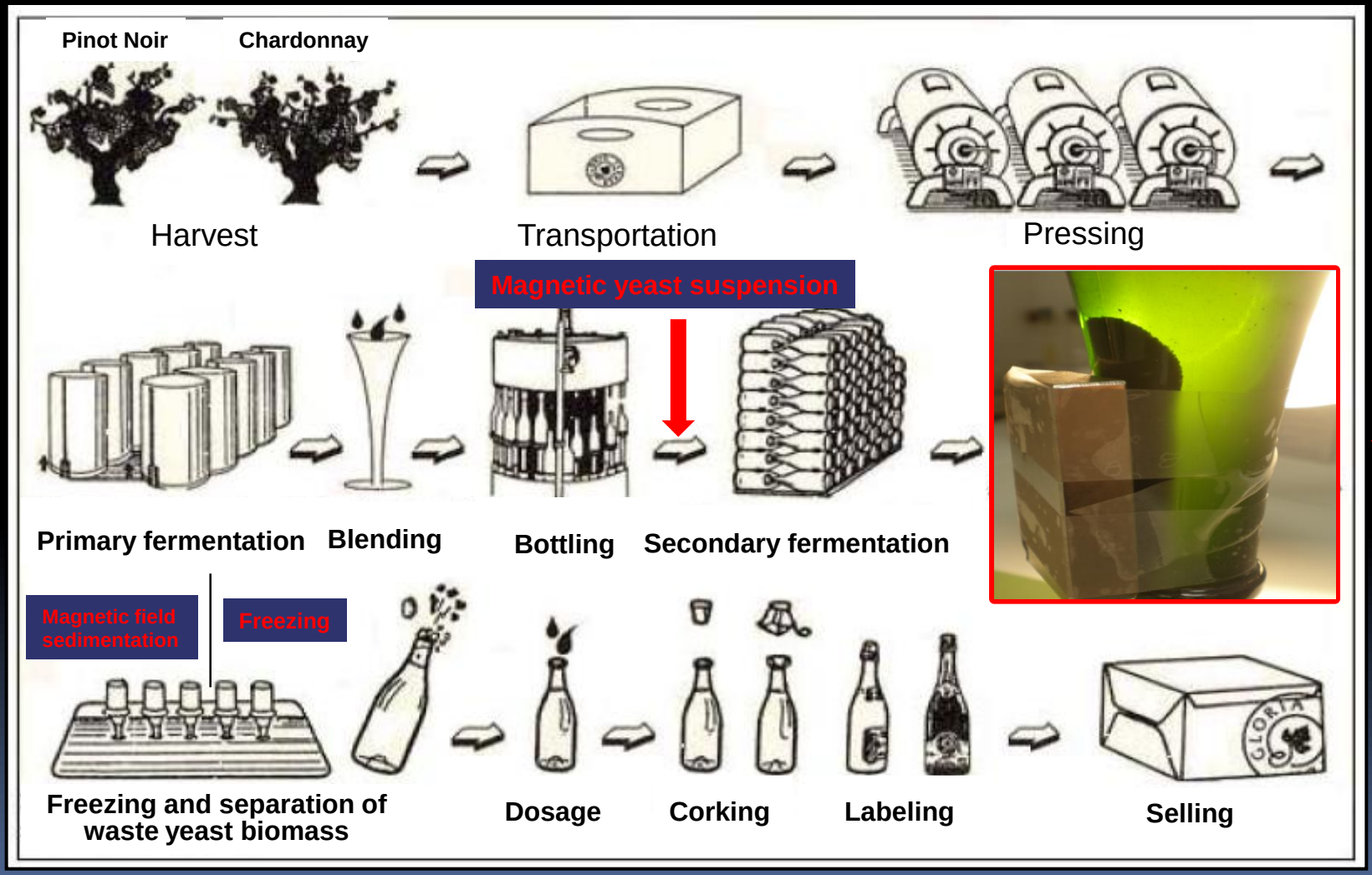




CONCLUSIONS

- 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 dioxyde 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 hydrocloric acid the stomach
- Separation of waste yeast biomass in magnetic field is 30 minutes

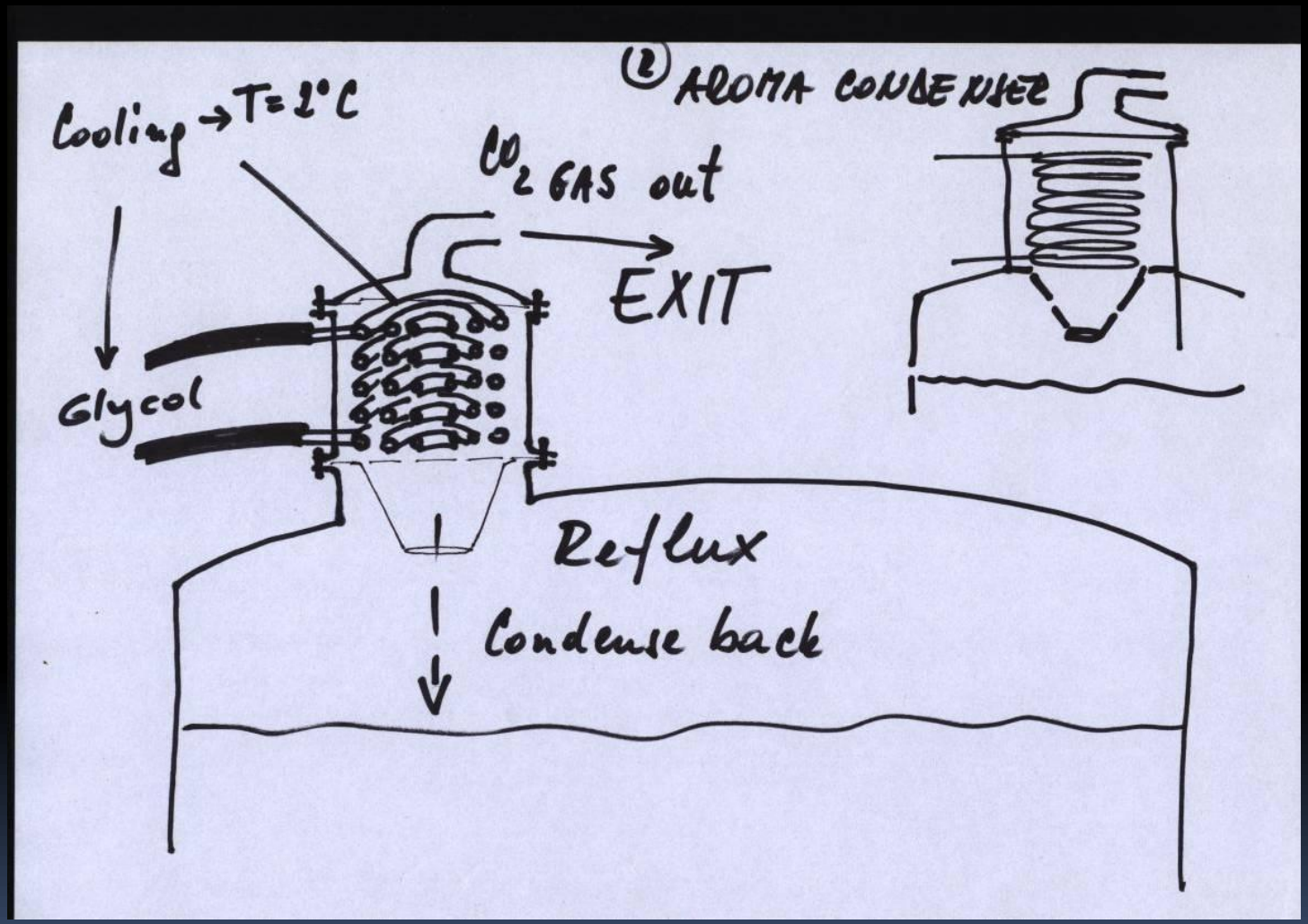
Innovations in Methode Champenoise Clasique



Ferric ion analysis

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

14


Cooling → T = 2°C
CO_2 GAS out
EXIT
Glycol
Reflux
Condense back
② AROMA CONDENSER