

# USING NUT SHELLS IN VINEGAR FERMENTATION

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**Goal:** Obtaining natural white wine vinegar with better organoleptic characteristics by using agricultural waste

**Solution:** Use of walnut shells (*Juglans regia* L.) and hazelnut shells (*Corylus avellana*) as a filler for plantations of acetic acid bacteria to obtain vinegar from white wine



- Advantages:**
1. Increases the contact area of bacteria with liquid;
  2. Reducing the time of obtaining the natural vinegar;
  3. Allows to achieve a white wine vinegar with improved organoleptic characteristics;



Cell immobilization materials used in vinegar produce in the world



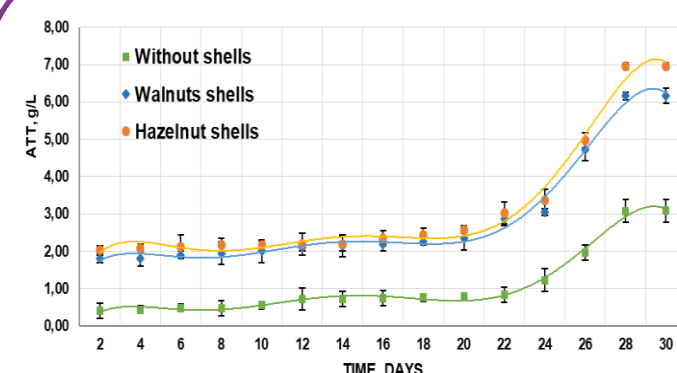
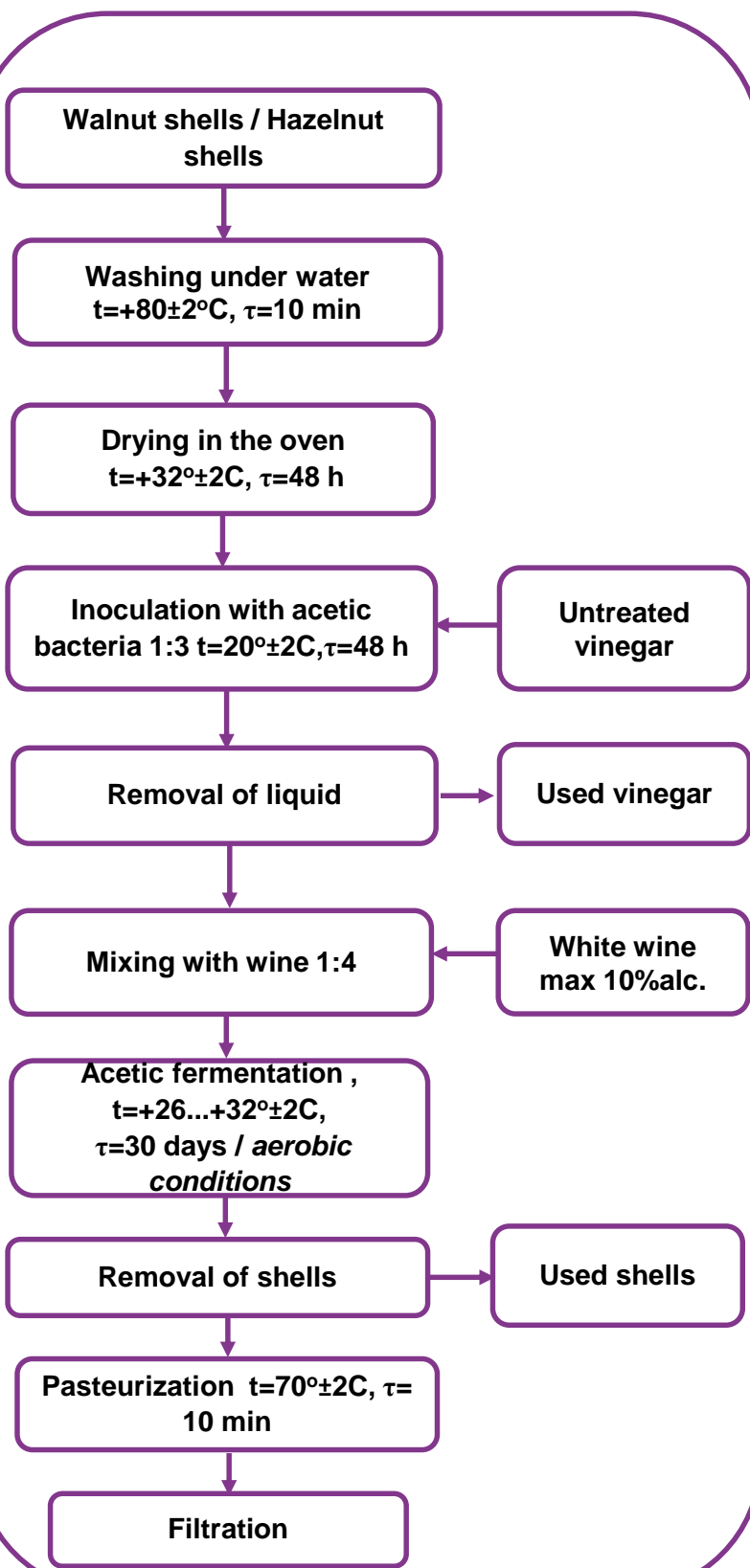
Local shells used in research, harvest of 2020

Physico-chemical parameters of untreated wine vinegar	Values	Image
pH at t=25 °C	2,9±0,25	
Total titratable acidity ATT, %	6,6±0,5	
Residual alcohol, %	1,5±0,25	
Density, kg/m <sup>3</sup>	1008±0,25	
Dry extract, g/L	10,75±0,55	
Ash content, g/L	1,75±0,5	

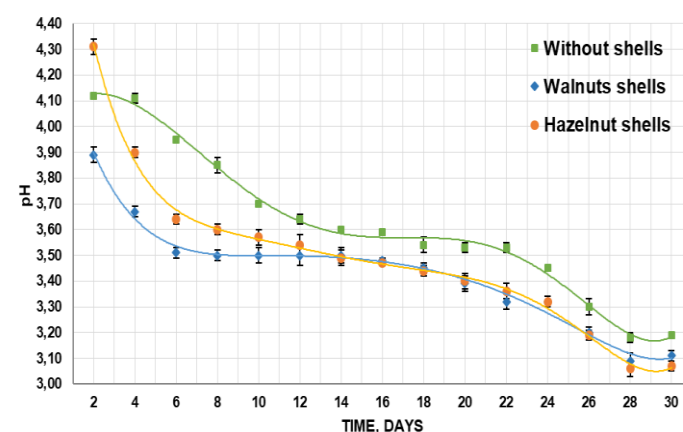
Physicochemical parameters of white wine vinegar used as leaven

Physico-chemical parameters of wine	Values	Image
pH at t=25 °C	3,7±0,25	
Total titratable acidity ATT, g/L	5,0±0,15	
Volatile acidity, g/L	0,47±0,5	
Density, kg/m <sup>3</sup>	986±0,5	
Dry extract, g/L	26,3±0,5	
Alcohol concentration, %	12,8±0,25	
Residual sugar, g/L	8,4±0,5	
Sulfuric acid concentration, mg/L	19,7±0,25	

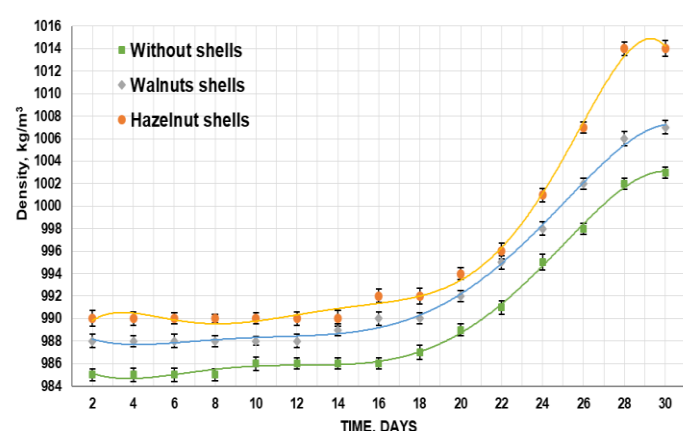
Physicochemical parameters of the homemade wine used for acetic fermentation



Relationship between period of fermentation (days) and total acidity (g/L).



Relationship between period of fermentation and pH.



Relationship between period of fermentation and density vinegar (kg/m<sup>3</sup>).

The research was funded by State Project  
20.80009.5107.10, nr. PS-62 "Personalized nutrition and intelligent technologies for my well-being",  
running at Technical University of Moldova