DISEASES AND DEFECTS IN WINE.

PHENOMENA OF CONTAMINATION

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The objective of the thesis – to become acquainted with the diseases, defects and phenomena of contamination in wines and how to prevent their occurrence in order to impede the alteration of the quality of products.

KEYWORDS – CONTAMINATION, WINE, QUALITY, MICROORGANISM, FERMENTATION.

INTRODUCTION

Wine is the final product of the fermentation of must. It is a product which can go bad through the action of microorganism. The modification of the chemical composition of wine under the influence of various factors leads to perception of taste and smell defects affecting quality. The term “quality” means "all the characteristics of a product”.

We talk about the quality of wine when:

- The substances it contains are in a harmonious proportion so that it may provide the consumer with a series of pleasant feelings.
- There is certainty that it does not contain substances which may cause the consumer indisposition and headache.

There are different factors which contribute to the definition of the quality of wine:

- the variety of cultivated grapes.
- environmental conditions (climate, nature of land and cultivation techniques).
- winemaking techniques
- compliance with hygiene.

DISEASES WHICH AFFECT WINE

“Wine diseases” are known as undesirable changes of composition and those organoleptic ones, which occur during the formation and preservation of wine due to microorganisms. Microorganisms can be found everywhere: in soil, air, plants and animals,
on fruit, on various object in cellars, on the walls of vessels and even in wine. They could have been seen and studied only after the discovery of the microscope.

Wine diseases are of microbial types (yeast, bacteria) and they affect its quality. When favorable conditions occur, microorganisms are activated, they begin to multiply and change the environment from a chemical point of view. For example, 1g of acetic bacteria manage to turn in 24 hours two litres of alcohol into acetic acid, or 1g of yeast transforms in the same period of time 800g of sugar into alcohol.

Microorganisms obtain their energy and nutrition necessary for life and multiplication by the degradation of certain existing compounds in must and wine with the help of enzymes, which they produce themselves.

Diseases occur when microorganisms are present in wine and when they have specific conditions of life and multiplication. In wine there may also exist several species of microorganisms (other population).

You can make a classification based on the influence that air has got in contact with wine. There are diseases caused by aerobic and anaerobic microorganisms.

**DISEASES CAUSED BY AEROBIC MICROORGANISMS**

These diseases appear in new (young) wines being closely related to the excess of air in the tank.

The major role in the rapid evolution of these diseases are as follows:

- the failure to fill up the wine tanks in time.
- Insufficient dose of free SO₂ in wine.
- lower alcoholic strength (8.5 to 10.5% vol.).
- keeping wines at temperatures higher than 12 - 14°C.

These are the most common diseases and they are due to fungi and bacteria that grow on the surface of wine (they need oxygen from the air). In this category there are pellicular fungi which cause the disease known as “the flower of the wine” and the acetic bacteria the wine to go sour.
1. **THE FLOWER OF THE WINE** is caused by types of yeast which are formed on the surface of wine, those Candida (Mycoderma) type, Hansenula and Pichia. They multiply rapidly, forming small pellicular spots of whitish colour on the surface of wine. These spots increase with time, merging and forming a white film, which thickens. When the film becomes too thick it breaks and falls to the bottom. The phenomenon is repeated as long as conditions permit.

Film formation is accompanied by changes in composition, taste and smell. Wine becomes opalescent, watery, tasteless, and when the disease progresses the smell changes and it becomes rancid.

Thus, wine becomes unfit for consumption. So Mycoderma oxidizes the alcohol and organic acids in wine causing the decrease of the strength of alcohol and the wine acidity:

\[
\text{CH}_3\text{-CH}_2\text{OH} + \frac{1}{2} \text{O}_2 = \text{CH}_3\text{-CHO} + \text{H}_2\text{O}
\]

The disease, although not dangerous in its incipient phase, causes through its evolution the degradation and downgrade of wine and favours the appearance of other diseases.

**Means of prevention and treatment**

It is recommended that the susceptibility of the wine to diseases be tested periodically. Take one sample of approximately 200 ml from each wine tank which we want to be tested, and fill a bottle of 250 ml up to about ¾. Cork the bottle and keep it for two or three days at 24 - 25°C. If the clearness of wine changes, a whitish film appears on the surface and its smell becomes rancid. This means that wine is prone to make a “flower”.

The main *measures* of prevention of the disease are:

- to use perfectly healthy wine grapes.
- to clear the white must through technological processes.
- correct antioxidant protection.
- proper management of fermentation.
- avoid the contact of products with air by filling up the tanks.
2. THE PROCESS OF TURNING SOUR OF THE WINE is produced by bacteria belonging to the Acetobacter genus. They cause serious changes in the composition of wine. Therefore the disease is dangerous and impossible to treat at a certain moment.

Visually, the wine forms a fine film which is transparent at first, and which later becomes thicker, grey, translucent mucilaginous.

Olfactorily, the suspicious wine gets a specific odour of vinegar, which intensifies as the disease progresses. Its taste also changes less significantly at first. It becomes more evident when the wine turns sour and gets a taste of vinegar.

Acetic bacteria can attack several groups of substances in wine: alcohols (ethanol, glycerol, sugars (glucose)), organic acids (lactic acid), but most important is the decomposition of ethyl alcohol to acetic acid and water.

\[
\text{CH}_3\text{-CH}_2\text{OH} + \text{O}_2 = \text{CH}_3\text{-COOH} + \text{H}_2\text{O}
\]

Consequently, the alcoholic strength of wine decreases and the volatile acidity increases. Once the acetic acid formed in wine, it is irreversible, thus there are no means of treatment.

White wines with volatile acidity bigger 1g/l and 1,5g/l for red wines are no longer given in consumption. These wines are used for manufacturing vinegar or for distillation.

Testing the predisposition of wine to turn sour is done similarly to that of testing the “wine flower”. After maintaining the samples at 24 - 30°C for two – three days, they are analysed organoleptically. Volatile acidity is determined and compared with the sample before the test/testing. In case of predisposition to turn sour, the specific odour and sour taste
occur, and the volatile acidity increases. A thin, translucent film is formed on the surface of the wine.

![Acetic bacteria](image)

**Fig. 2 Acetic bacteria**

**DISEASES CAUSED BY ANAEROBIC MICROORGANISMS**

Such microorganisms (yeast, bacteria) grow in the mass of wine safe from air and do not oxidise the alcohol. They attach the remaining unfermented sugars in wine, the secondary products of fermentation (glycerol) and the organic acids.

The diseases they cause are rare, but very serious for the quality of wines.

1. **HOW DOES WINE TURNS SOUR UNDER THE INFLUENCE OF LACTIC ACID**

   **Mode of manifestation** - The affected wine loses its clearness, changes its colour and unpleasant nuances of pear in its taste and smell. Bubbles of CO2 are formed in the wine, the viscosity increases, and a deposit of secondary products is formed at the bottom of the tank.

   The process of turning sour is caused by a group of bacteria which break down the sugars in wine. Wine becomes turbid (cloudy) it gets a bad smell of rotten fruit, sauerkraut or vinegar, and its taste is sour (tanks to lactic and acetic acids). The disease develops in must which are fermenting and in wines with debris of unfermented sugar, low in alcohol and acids.

   Wine turn sour only in warm autumns, especially wines which are fermented at temperatures too high (30 - 35°C), when yeast fermentation activity is impeded.

   **Pathogenic agents** are parts of the group of lactic bacteria, dominant species being Bacterium Intermedium.
Measures taken to prevent wines from turning sour:

- correction of must with very low acidity by adding tartaric acid.
- clarification of must before fermentation and then fermentation with selected yeasts.
- cooling the must when the temperature in the tank tends to exceed 28°C.

Opportunities aimed at preventing the disease: rational sulfitation of the must and wine so that the content of the free SO₂ will not fall below 30 mg/l in white wines and less than 15 mg/l in red wines; the correction of acidity in the must and wine (with tartaric or citric acid); the use of selected yeasts to ferment the must and proper management of the metabolizing process of carbohydrates; filling up the tanks.

Treatment of sour wine: if the disease is only at the beginning the wines are pasteurized so that pathogenic agents are destroyed and the evolution of the disease is stopped. Then yeast is added to the wine by fermentation of sugar residues.

In the absence of a pasteurizer unit, the wine is given 5-6 g of SO₂/hl and then it is filtered. The wines strongly affected become improper for consumption; they are destined for manufacturing vinegar or are distilled for the recovery of alcohol.

Fig. 3 wine soup
Left - bacteria; right - wine affected
2. PROPIONIC FERMENTATION OR BACTERIAL DEGRADATION OF TARTARIC ACID

The disease occurs mostly in warm wine growing zones or even in vineyards with a cooler climate when springs and autumns are extremely hot. The appearance of the disease is found in young wines, low in alcohol and acidity, but which contain residual sugar.

Mode of manifestation

At the beginning there is a weak carbonic gas disposal which is gradually increasing/intensifying creating a certain pressure in the closed tanks.

The pathogenic agents belong to the group of lactic bacteria, among which the species Bacterium tartarophthorum has the leading role in the development of the disease.

The preventing measures of the disease are those described mentioned at:

- correction of must with very low acidity by adding tartaric acid.
- clarification of must before fermentation and then fermentation with selected yeasts.
- cooling the must when the temperature in the tank tends to exceed 28°C.

Fig. 4 Fermentation propionic

Left - young cells, right - old cells
3. ROPINESS OF WINES

Malady appears frequently at viticultural areas with a cooler climate. Young wines low in alcohol are affected, poor in tannin, with moderate acidity, nitrate-rich and with residual sugar content.

Mode of manifestation. The disease commences with the opacity of the wine. The product muddles and it takes on a viscous aspect, of mucilaginous consistency. By the air coming in contact with the wine, disengagement of CO$_2$ takes place, the product presents a ropy aspect, and when it is poured into glasses it flows in continuous strings (as oil). By appearance the wine is muddled and of ashen colour. It tastes flavourless, oily, and volatile acidity is increased (vinegar smell). Ropiness appears mainly in Spring among wines unseparated from the sediment and even among those bottled too early.

The pathogenic agents of the disease are lactic bacteria: *Bacillus viscosus vini*, to which (in some cases) acetic bacteria associate as well, and even the fungus *Dematium pullulans*.

Prevention of ropiness is done by:

- the separation of rotten grapes from the healthy ones
- rectifying the lack of acidity in the must
- the fermentation of musts with some of the skin in order to compensate the lack of tannin
- blending wines poor in tannin and alcohol with others rich in these two components
- racking off wines exposed to ropiness in contact with as much air as possible.

Treating ropy wines: The wine that started ropiness need to be poured into a smaller pot where it is beaten powerfully with a small besom until frothiness. High quantities of wines are aired by homogenisation with pumps. Sulphites are added to the wines (4-5 g SO$_2$ for 100 l of wine) and are treated with tannin and gelatin (10-15 g for 100 l of wine), mixed with bentonite or kieselgur. A certain method of treating ropy wines is by stirring them on air, followed by their sterilisation through pasteurization or filtration. If ropy wines did not change their taste after applying the treatment, they need to be given in consumption without delay, either in a pure state or after blending them with normal wines.
4. BITTERNESS OF WINES

The disease does not impregnate in white wines, only in some red wines bottled long ago. Wines obtained from mouldy harvests are predisposed to the disease. The characteristic of this disease is an intensive bitterness. The disease results to bacteria that belong to the Bacillus amaracrylus species. These attack the glycerol in the wine.

*Mode of manifestation.* Initially, a characteristic smell emerges, the wine becomes flavourless, unpleasant but it stays clear at this stage. As soon as the disease advances a strong bitterness appears in the product. The taste becomes acrid, a weak disengagement of CO$_2$ takes place as well, and even sparkling as the bottle is opened.

![Fig. 5 Bacteria Dematium pullulans](image)

![Fig. 6 Bacteriile amarelii](image)
WINE FAULTS

Wines can have certain faults that make them inadequate for consumption if the faults cannot be averted.

➢ BIOCHEMICAL TRANSFORMATIONS, resulting in wine faults, are triggered by some enzymes. Muddling caused by enzymes is due either to hydrolysis processes (hydrolytic dissolution) or the oxidation of polyphenols in wines (oxide dissolution).

1. WINE BROWNNESS (brunification) is a fault triggered by oxidant enzymes (ferment) developed by the mould on the grapes. Initially, the colour of white wines turns deep yellow then tan. As a result of oxidation, red wines begin to fade gaining the colour of tea or boiled prune juice. The wine tastes flat at first then unpleasant.

Preventing wine brownness is done by the following steps: moulded grapes are collected and vinified separately; they need to be pressed rapidly and the must is treated with increased doses of SO2.

2. HYDROLASE DISPOSAL

The transformation involves hydrolysis and condensation phenomena of the coloring matter, after which it becomes increasingly less soluble, finally getting the colloidal state.

The process is caused by a hydrolase, able to split (hydrolyse) mono and bi-glucoids resulting aglicons (antocianidines) and glucose.

➢ PHYSICO-CHEMICAL TRANSFORMATIONS

1. TARTARIC PRECIPITATION - In winemaking practice it was found that in the whole mass of wines (especially in the younger ones) crystals appear in different sizes after the first frosts of winter, which then settle. The sediment is composed of insoluble salts of tartaric acid (potassium hydrogen and calcium tartrate).

Mode of manifestation. Crystalline formations of the two salts cling to the walls of wood and concrete containers, forming winestone.
Technological possibilities to stabilize wines against tartaric precipitation involves the following factors: cold, the association between CO2, low temperature and filtering, metatartaric acid, acacia gum and gentle heating of the bottled wine.

2. PROTEIC DISORDER (proteic disposal): It is more customary at young white wines and those used as raw material for obtaining champagne.

Mode of manifestation. First, wines become opalescent, this gradually increases, until wines obtain a whitish conformation. Then follows the formation of precipitates which settle in a light and bulky, gray-white sediment. These rise in the whole mass of the product to the slightest movement of the bottle. The sediment is composed of protein substances (80%), polyphenols, polysaccharides, minerals, etc.

Technological possibilities of avoiding the proteic defect call for procedures based on the constitution of precipitates, as well as their deposition and adsorption phenomena.

3. FERRIC PRECIPITATES: These defects are also called ferric disposals. They occur in wines with an increased iron content and within specific aeration conditions. Disorders are caused by the oxidized form of the iron (Fe3+) and low temperatures which favors falls ferric precipitates.

a) Phosphate-ferric disposal or white disposal. Occurs in white wines when they are aired.

Manifestation. Wines are opalescent and get a whitish tint. In the whole mass of the product there can be noticed gray coloured precipitates that settle. The formed sediment contains: trivalent iron, phosphoric anion, calcium and protein.

b) Black and blue disposal. Appear in white and red wines being determined by combinations of polyphenolic constituents and iron in its oxidized state (Fe3+). Combinations formed between tannin and iron causes blue disposal, while those between anthocyanins and iron determine black disposal.

In general, the higher the polyphenolic constituent and the pH value, the higher the proportion of oxidized iron entering the combination.
Factors which withstand iron-brownness of the wine are citric and malic acids.

Citric acid has an approx. 3.5 times stronger effect than malic acid. The capacity of citric and malic acids to withstand ferric disturbances is explained by the formation of complexes with very low dissociation constant. Other factors that preclude the occurrence of ferric defects are: substances of diminishing nature (ascorbic acid, SO2) and protective colloids (gums, mucous, etc.)

c) Copper disposal. Precipitates derived from some copper compounds resulting in disorders, occur in white wines that are already bottled, containing certain proportions of sulphur dioxide in its free state. The defect is due to the reduced form of copper.

Mode of manifestation. In the affected bottled wines appear diverse fragments of precipitates which gather either on the neck of the bottle, or forming a kind of trail or strip lying on the bottom of the bottles. The formed deposit has a reddish-brown colour.

CONTAMINATION OF WINE

Wine is a biological fluid subject of microbial, as well as nonmicrobial contamination.

1. NONMICROBIAL CONTAMINATION

They are caused by metals (unwanted cations such as Calcium, Iron, Copper, Zinc, Lead/Plumb) due to an improper maintenance and use of containers and equipments that are not able to resist the effects of corrosion and mechanical erosion.

2. MICROBIAL CONTAMINATION

Microorganisms are considered to be primarily responsible for wine alterations, which can occur at various stages of processing and preservation.

One can reach a lower clearness/purity of the wine.
SOURCES OF MICROBIAL CONTAMINATION

a) raw materials

b) tools used for harvesting, transporting, receiving, crushing and other processing of grapes

c) units of work: floors, walls

d) atmosphere

e) recipients/ containers

f) bottling lines, installations and equipment to stabilize wine

g) appropriate personnel

h) disinfection.
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