

Single cell protein from grape pomace: Sustainability in the winery to value-added food- Review

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Introduction

- During the red and the white vinification, a large number of by products is produced
- In Greece, it is estimated that the annual production is about **525,000 tons of grapes** which leads to **142,000 tons of winery waste**
- **100 kg fresh marc** are constituted from **30 kg** of fresh **pulp**, **25 kg** of fresh **seeds** and **20 kg stalks**



- Recent studies showed that winery by-products may negatively affect the environment by presenting **toxicity to crops and wetlands**
- Researches focused on wastewater of wineries were considered to be responsible for the **contamination of groundwater resources**





Sustainability in the wineries

Encourage wineries to apply value adding technologies in order to:

- **Reduce** their waste generation and disposal
- **Provide** further alternatives to diminish the environmental impact of the winery activity
- **Introduce** additional sources of income

Grape skin & grape seed

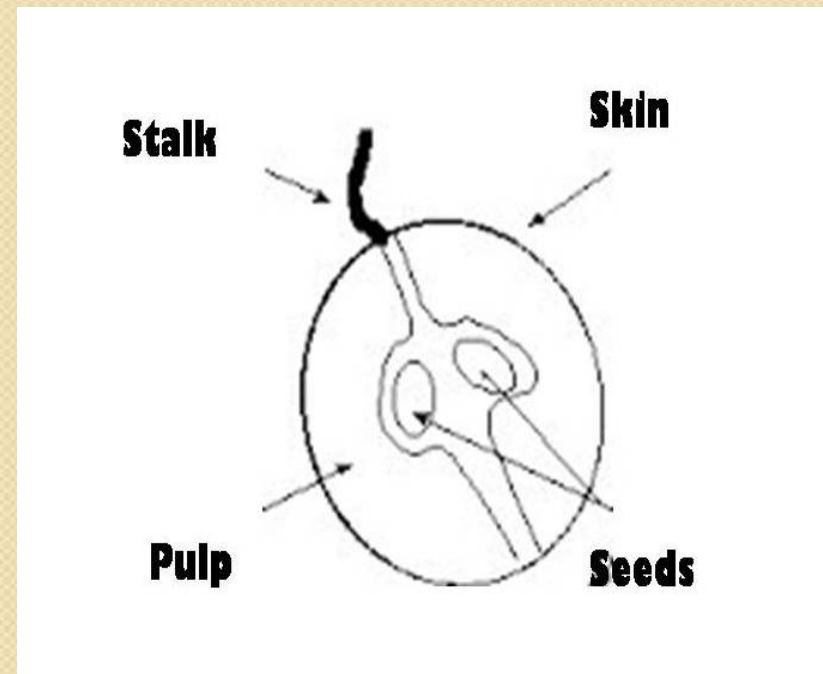
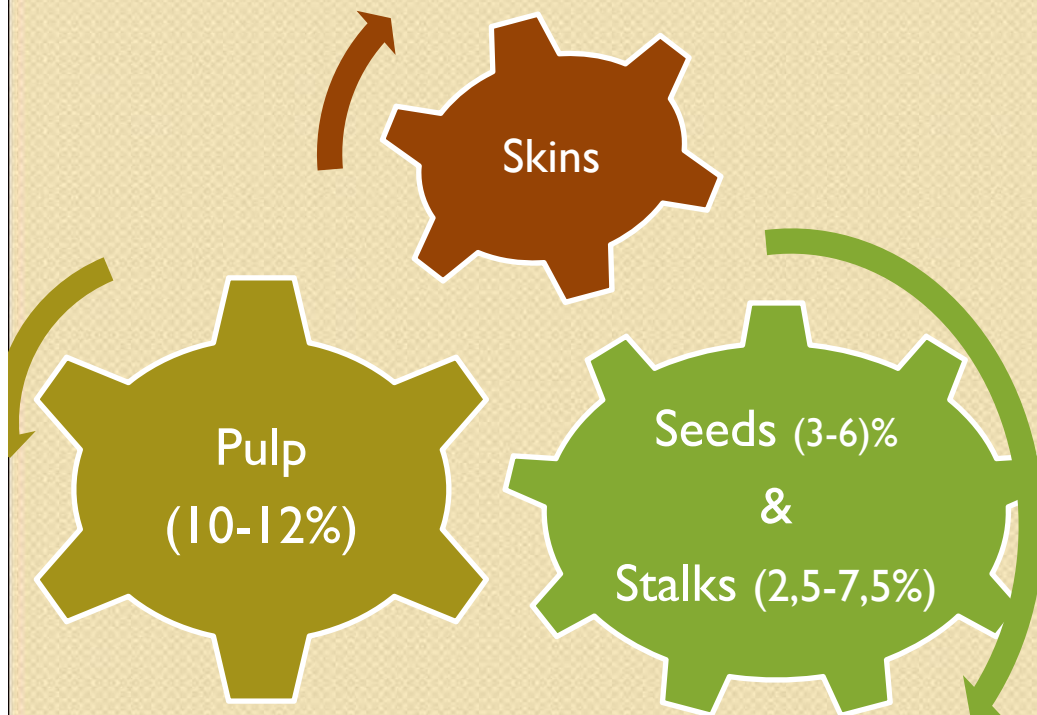
- They are the main by-products
- Used: ➡ produce another product (grape seed oil)
➡ compost for the production of alcohol
➡ create a new type of human food
(grape seed powder)



Grape pomace

-Definition

- The solid remains of pressed grapes
- It is equivalent to about 20% of the grapes used
- Result after pressing grapes for juice or oil
- It contains:



Conventional applications

Animal Feeding



Grape Seed Oil



Fertilizer



More applications



- **Pulp** can be composted after mixing with other minerals and used as **fertilizer**
- Grape pomace: **fermented** with special crops and produce **high added value and purity substances such as polysaccharide or produce alcohol**
- Using grape pomace with the composting process; **substrate for plants & substrate for cultivation of mushrooms**
- Fermentation with different microorganisms & different treatment (hydrolysis or not) ➡ the extraction of tannins & polyphenols

Microbial protein Definition

- It refers to dead, dry cells of micro-organisms such as yeast, bacteria, fungi and algae which grow on different carbon sources.
- The name "**single cell protein**" was used to give a better image than "microbial protein."
- Also known as " Novel Food " or " Mini Food "

Microbial protein: Advantages

Utilization of grape by-products in the production of microbial protein will help in controlling pollution

Help solving waste disposable problem to some extent

Satisfy the world shortage of protein rich food

High protein content (about 60-82% of dry cell weight), fats, carbohydrates, nucleic acids, vitamins and minerals

Rich in certain essential amino acids like lysine, methionine which are limiting in most plant and animal foods

Microbial protein: Usages

Additive to the main diet instead of sources known very expensive (soya bean and fish)

Grape pomace with good nutrient content can be **converted** into food enriched with protein and feed and by properly utilizing them, will bring an end to the **protein deficiency** around the world

Good nutritious food can be supplied with least expenditure of cost

Where microbial protein is used?

- **Animal nutrition**

fattening calves, poultry, pigs and fish breeding

- **Foodstuffs area**

aroma carriers, vitamin carrier, emulsifying aids and to improve the nutritive value of baked products, in soups, in ready-to-serve meals, in diet recipes

- **Technical field**

paper processing, leather processing and as foam stabilizers



Production process of microbial protein

Substrate (wood, carbohydrate, methanol)



Fermentor (bacteria, yeasts, fungi, algae)



Filtration & Drying



Production of microbial protein

Fermentation process (I)

- Grape and wine by-products are a good source of carbon and have been used to generate various high-value products
- Major components of grape biomass waste are cellulose pectins and lignins (including tannins)
- Fungi belonging to the division Ascomycota, such as *Trichoderma* spp., *Aspergillus* spp., *Penicillium* spp., are known for their biomass degrading ability and should prove useful in grape biomass degradation
- Protein rich products can be used as feedstock for animals.
- The protein content of grape marc has been managed to be increased from 7% to up to 27% in **five days** using solid state fermentation process, certain fungal strains and specific conditions like temperature and moisture content



Fermentation process (II)

- *Pleurotus ostreatus* is the third most important edible mushroom cultivated worldwide
- It can easily decompose lignocellulose without chemical or biological pretreatment as it possesses an enzymatic complex system that includes phenol oxidases and peroxidases
- Therefore, they can be utilized and recycled by solid state fermentation (SSF) using various strains of mushroom
- The bioconversion of vineyard prunings and grape pomace by *Pleurotus* spp. with SSF was evaluated by measuring the fruiting body as alternative attempt for recycling of winery agroindustrial wastes

Grame Pomace + Microbial Protein



Sustainability in the winery

- **Environmental concern** is leading consumers to demand for **products** which take **environment issues** into account, such as organic food, carbon neutral products or water-friendly products
- Sustainability is not referred only in the **vineyard** but it refers also to **energy conservation, solar** and other renewable sources, efficient and recycled construction and winery's overall **carbon footprint**
- **Consumers are willing to pay more** and to support wines produced from **green production** practices that leads to sustainably produced wines
- **More importance** to the **issues of natural resources** that to the water savings in wine production and that can be related to the fact that consumers are less familiar with the issue of water consumption in food production
- One more useful strategy for wineries aiming towards **reducing environmental contamination** and as an alternative to **reduce the carbon footprint in the wine production process** (sustainability in the winery) as part of the Sustainable Development Goals (SDGs)

Ongoing research work

- A series of experiments are planned to be performed to obtain an optimized protocol for degrading winery biomass waste.
- Both submerged fermentation and SSF processes will be assessed using different fungus
- The fermentation process will be held in a solid state fermentation **bioreactor**, designed specifically for the needs of this research where conditions like temperature and pH were measured on a regular basis.
- Various **analyses** (temperature, pH, ash, total nitrogen) will be performed on both, the substrate and the fermented product.

Conclusion

- Introduction of grape pomace as a new vehicle to produce **microbial protein**
- One of our goals is to prove that grape pomace have compounds with **beneficial effects** when correctly used as a substrate allowing the valorization of winery by- products and produce value-added products.



Thank you for your attention!



Oin♠sporos

Handmade beauty products from grape seed oil

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