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I. Winemaking By-Products

The by-products of grapes are the materials or components obtained as a result of the winemaking process. These by-products can be recovered and used for various purposes, or in some cases, they are sought to be avoided due to their potential negative impact on the final product. The most common by-products include grape pomace, grape seeds, wine lees, and wine acids.

- Grape Pomace: Grape pomace consists of the solid remains of the grape after the juice is extracted. It includes skins, pulp, and seeds, and contains valuable compounds such as polyphenols, antioxidants, and fibres. Grape pomace can be used for various applications, such as producing grape seed oil, composting for organic fertilizers, or even as animal feed supplements.

- Grape Seeds: Grape seeds are rich in oil, antioxidants, and other beneficial nutrients. After separating from the skins, grape seeds can undergo extraction and refining processes to obtain grape seed oil, which has applications in the food and cosmetic industries.

- Wine Lees: Wine lees are the solid residues that settle at the bottom of containers after wine fermentation. These sediments mainly consist of dead yeast, grape cells, and other solids. Although excessive presence of lees in wine is undesirable, in certain cases, they can be used in aging processes on lees, which impart complexity and particular characteristics to the wine.

- Wine Acids: The acids present in wine are essential components that affect its taste, structure, and balance. However, in certain situations, it is necessary to control acid levels to avoid unpleasant flavours or excessive acidity in the final wine. Acid correction techniques can be used to adjust proportions and obtain a more balanced wine.

Overall, grape by-products are an important part of the wine industry, as they allow the recovery of valuable compounds and resources that can be used in various applications. At the same time, it is essential to manage these by-products properly to avoid possible negative impacts and promote sustainable practices in wine production.

II. Tartaric acid

Tartaric acid is a natural organic element extracted from grapes, found in musts and pomace. It is a white, crystalline, and odourless substance with versatile qualities, serving as an acidifier, antioxidant, stabilizer, and pH corrector in various industries.

In winemaking, it acts as a natural acidity corrector, enhancing taste and brightening colour. In the food sector, it serves multiple purposes. It functions as a leavening agent in confectionery and desserts, and as an acidifier and natural preservative for jams, juices, and preserves. It is also used in table water for effervescence.

Calcium tartrate, containing 50% tartaric acid, is sent to chemical industries to produce pure tartaric acid. This pure acid has various applications:

- In construction, it acts as a retarder for gypsum setting.
- In the food industry, it functions as a leavening agent, acidifier, antioxidant, flavour enhancer, and stabilizing agent (E-334).
- In the wine industry, it corrects acidity in wine.

III. Grape Seed Oil

Grape seed oil is extracted through cold pressing and refined using mechanical processes, avoiding chemical solvents. It stands out for its high linoleic acid content, an essential omega-six fatty acid that effectively lowers cholesterol levels. Additionally, its abundance of antioxidants provides cardiovascular health benefits.

In the culinary domain, grape seed oil is perfect for cooking due to its high smoke point and can be used as a raw dressing or as an ingredient in various recipes.

Cosmetically, this oil serves as an antioxidant, safeguarding the skin against premature aging, weather effects, and free radicals.

With a fruity touch, this oil solidifies at lower temperatures, making it an excellent choice for marinating fish, meats, and creating dressings. It's also a valuable component in cosmetic products due to its high linoleic acid content, providing smoothness and texture to the skin.

Rich in Vitamin E, Omega-6, and Omega-3, grape seed oil supplies essential nutrients that the human body cannot produce, necessitating inclusion in the diet.

Furthermore, it's cholesterol-free and promotes "good cholesterol" (HDL) while reducing "bad cholesterol" (LDL) and triglycerides, making it an essential supporter of cardiovascular health, and a preventive measure against hypertension, obesity, and diabetes.

IV. ENOCYANINE

It is an extract of anthocyanins and polyphenols from red grapes, obtained from their grape skins, which have high colouring and antioxidant activity.

During the grape harvest season, batches with higher anthocyanin content are selected at the factory's grape intake. These batches undergo a washing process and subsequent vacuum concentration.

The resulting concentrate, with a richness of 40 gr/l of anthocyanins, is sent to industries that purify and prepare it for sale in the form of liquid concentrate or powder.

Nutraceuticals uses:

- Antioxidant to combat the effects of free radicals.
- Provides grape polyphenols.
- Contains flavonoids.

V. ETHYL ALCOHOL

Ethyl alcohol, commonly known as ethanol, presents itself as a clear liquid with a distinct pungent aroma and a mildly sweet, fiery flavour. Its volatile nature and extreme flammability are notable features.

When intended for food consumption, it becomes neutral ethyl alcohol or food-grade alcohol, boasting an alcohol concentration of around 96% volume. This particular type of alcohol finds its purpose in crafting liqueurs, brandies, and fortified wines like Port and Sherry. On the other hand, crude ethyl alcohol tailored for industrial use can vary in alcoholic concentration and sensory attributes, depending on the specific needs of customers.

VI. Example Companies

Within this section, we will dive into a selection of companies that have cleverly harnessed the potential of winemaking by-products, transforming them into valuable resources and making significant contributions to sustainability and innovation within the industry.

VI.1 AGRALCO

Agralco is a company in Navarra, Spain, focused on the transformation and revaluation of winemaking by-products.

Agralco obtains various products through the management of these materials:

- 5,200,000 Liters of neutral alcohol of vinous origin.
- 800,000 Liters of distilled spirits or wine brandy.
- 2,500 metric tons of calcium tartrate with a tartaric acid content of 50%.
- 1,200 metric tons of grape seed oil from the 8,000 metric tons of grape pomace.
- 8,000 metric tons of biomass (defatted grape seed flour).
- 300 metric tons of natural colouring agent (enocyanine).
- 3,000 metric tons of organic amendment for application in crops.

Additionally, for self-consumption, they generate:

- 10,000 metric tons of biomass (dried grape skins).
- 1,750,000 Nm3 of biogas, which produces 4,375 Mw.h. of energy in their cogeneration engines.

VI.2 La Alcoholera

Founded in 1934, La Alcoholera de La Rioja, Ebro y Duero, currently known as La Alcoholera, has been dedicated over these 89 years to the production of alcohols, tartrates, grape seeds for oil, and biomass from the by-products of the wine industry.

VI. 3 "GIN RIOJA"

Bodegas Riojanas and Destilerías Riojanas are collaborating on a project to create gin infused with natural aromas from Rioja wine. They aim to explore the feasibility of using wine fermentation by-products in the production process. Through the "GIN RIOJA" initiative, Bodegas Riojanas captures aromatic extracts from selected vineyards' grape fermentation, which would otherwise escape into the atmosphere. The project also integrates energy-efficient technologies to reduce environmental emissions by utilizing CO2 for other applications.

VI. 4 Doc Design

Doc Design, La Rioja, Spain, extracts several components from wine residues. These components are of great interest due to their antioxidant properties, which are highly beneficial for the nutraceutical and cosmetic industries.

These residues are processed to obtain high-value active ingredients used in the production of certified natural cosmetics. Solid compounds rich in antioxidants are extracted from grape pomace for use as exfoliants.

From the processed lees, a wine paste is obtained for making masks and wraps, along with an extract used in creams and lotions. Additionally, a powder rich in bitartrates is obtained from the solid residues of the barrels, which is being developed into a new line of products for treating skin blemishes.

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