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# The Use of Grape By-Products as a Nutrient Rich Cattle Feed

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In this article you will learn about how to use the grape stems, skins and pulp that are generated by the wine industry. Ruminant animals such as cattle can digest this inexpensive yet nutrient rich material. The complete process from wine press to cattle feed is covered in this article. The historical background of using grape by-products and methods to preserve this food source is also presented.

## Introduction

### A Historical Prespective

In this edition of the Pacific Rural Press, the Stockton Mail has found great interest and conversation among the vineyard owners about this year's crop. The 1904 crop is looked upon to be excessive for the wine-making product with grape prices low. Mr. Ed Ladd of Stockton, California was approached and agreed to tell us his story about dealing with this exact situation a few years back.

During the mid-1880s Ed found a unique way of managing grapes that are unfit for shipping or when prices become too low. He discovered through his own research that mules could be fed leftover grapes or reject raisins and still be kept in top notch condition. Ed repeated his experiment with dairy cows and found similar results.

As Ed explains, "We used to lose a mule every once in awhile, owing to the dry feed. They would simply keel over and die. As a physic, to counteract the effect of eating nothing but hay and barley, I used to put hyposulphate of soda in the water trough once a week. But after they began to eat grapes instead of barley there was no trouble, and we lost no more animals. I fed grapes to the milch cows also, with like good effect."

Ed recommends drying the grapes because they will not keep for long otherwise. The process for doing this is laying the grapes out in the sun on top of ordinary paper or muslin.

"My impression, gained by observation, is that it will pay to feed grapes to stock when the price is only $7 or $8 a ton [1880's currency]. There is going to be a large amount of culls this season, made up of Tokays and Muscats, that can't be made into wine, and the surplus can be disposed of to advantage by feeding to stock."

The Stockton Mail decided to seek out further information about the utilization of the grape crop surplus. Professor M. E. Jaffa of the State University [California] passed on his knowledge about the subject at hand. He states that, "Grapes, either fresh or dried, should only substitute a part of the feed ration that is normally grain, but to keep the amount of hay the same."

Prof. Jaffa says, "While it is true that all the elements necessary to support life are found in the grape, it must not be forgotten that the main nutritive ingredient is the sugar. The nitrogenous elements so necessary in all rations are present only to a very small extent in the grape, fresh or dried."

"Consequently, if raisins were used as a food for dairy cows or other animals, some highly concentrated nitrogenous material, as the oilicake meals or gluten meals, would or should be fed in connection there with to supply the deficiency in nitrogen."

Prof. Jaffa finishes his analysis with "Just how much fruit can be fed with safety to the different farm animals cannot be definitely stated. Careful experimenting on the part of the feeder would soon determine that point."

**Now, fast forward to 2017** and Short Sheep Vineyard & Micro-Winery located in Mudgee, Australia. Tony and Sue tell their story of operating their business with sustainability along with smart management of their product including their livestock. Their cows are fed grape marc to reduce their methane emissions. Grape marc also known as grape by-product and pomace, is the skins, pulp and stems left over when wine is produced.

**Grape By-Product as a Cattle Feed**


**Figure 1** Grape Marc As Cattle Forage.

Short Sheep Vineyard & Micro-Winery have fed their cattle wine waste for years. The cattle shown here are feeding on grape marc fresh from the basket press. This distributes beneficial nutrients across the fields and keeps their cattle fed during drought periods.
"This photo was taken in drought and the cows came straight over and started munching before we had a chance to get the marc off the Ute!"
Sue, Head Ewe.
(Content used with permission from Short Sheep Vineyard & Micro-Winery)

**Figure 2** Flyfaire Wine's Sweet Riesling Cake composed of compressed grape marc being transported to cattle feeding area. (Image used with permission from Les Hanel and Julianne Cox, Flyfaire Wines)

**Figure 3** Cattle feeding on the grape marc cake. (Image used with permission from Les Hanel and Julianne Cox, Flyfaire Wines)

Both of the above mentioned companies take a unified approach to using grape marc. Flyfaire Wine and Short Sheep Vineyard & Micro-Winery feature both vineyard and cattle production facilities. This allows the business to take grape waste products from one side and find an economic use for them as cattle feed. This also allows them to regulate the pesticide and fungicide used on the grapes to ensure that chemical residues are not harmful to their livestock. When the decision has been made to feed grape marc to cattle, it is recommended to have an accredited lab to test for the level of chemical residues.

An example of a dried grape feed ration is 9.0 kg of alfalfa hay dry matter per day (DM/d), 5.0 kg of dried grape product DM/d, and 4.3 kg of concentrate mix DM/d. The concentrate mix was d 93.0% crushed wheat, 4.7% dried molasses, and 2.3% mineral mix (DM basis). In this experiment all the ingredients were measured out and mixed by hand. However, similar results would potentially result if the study used an automated feed mixing system. One half of the dried grape feed ration was fed during the morning and the other half in the afternoon.[8] In another study the weight gain was found to be similar between fattening steers with barley or substituting 20% of feed (82% of the barley ration) with grape marc.[15]

**Table 1** Comparison between dried grape product (raisins) and stem rejects versus alfalfa. The researchers say there was a high ratio of stems to raisin material.[1]

| The chemical composition of feeds (g/kg/DM) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Feeds | DM | CP | NDF | ADF | Crude fat | OM | Total phenols | Total tannins |
| Alfalfa | 931.4 | 122.3 | 548 | 436 | 28 | 930 | 0 | |
| Dried grape by-product | 884.5 | 63.5 | 259 | 255 | 112 | 926 | 67 | 52.3 |

DM=dry matter, CP=crude protein, NDF=neutral detergent fibre, ADF=acid detergent fibre and OM=organic matter.

## Grape Marc Processing

After the grape harvest season, approximately 523,000 metric tons of grapes are crushed to extract the economically valuable juice before the remaining material is sent to the landfill.[9]

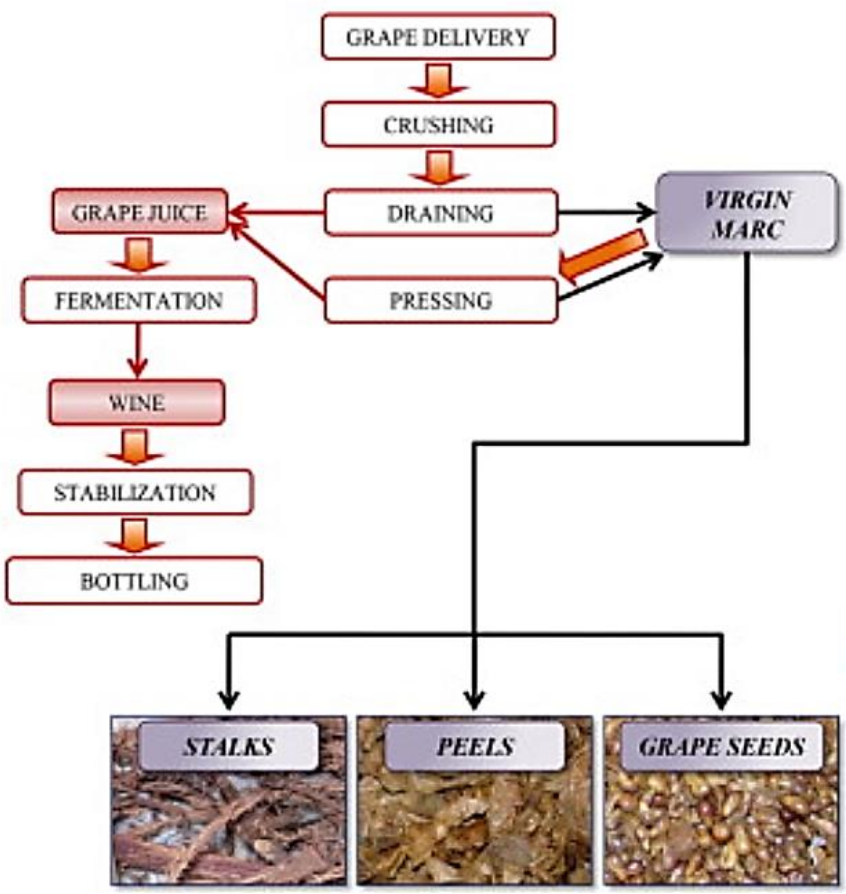


**Figure 4** White wine production processes.[14]

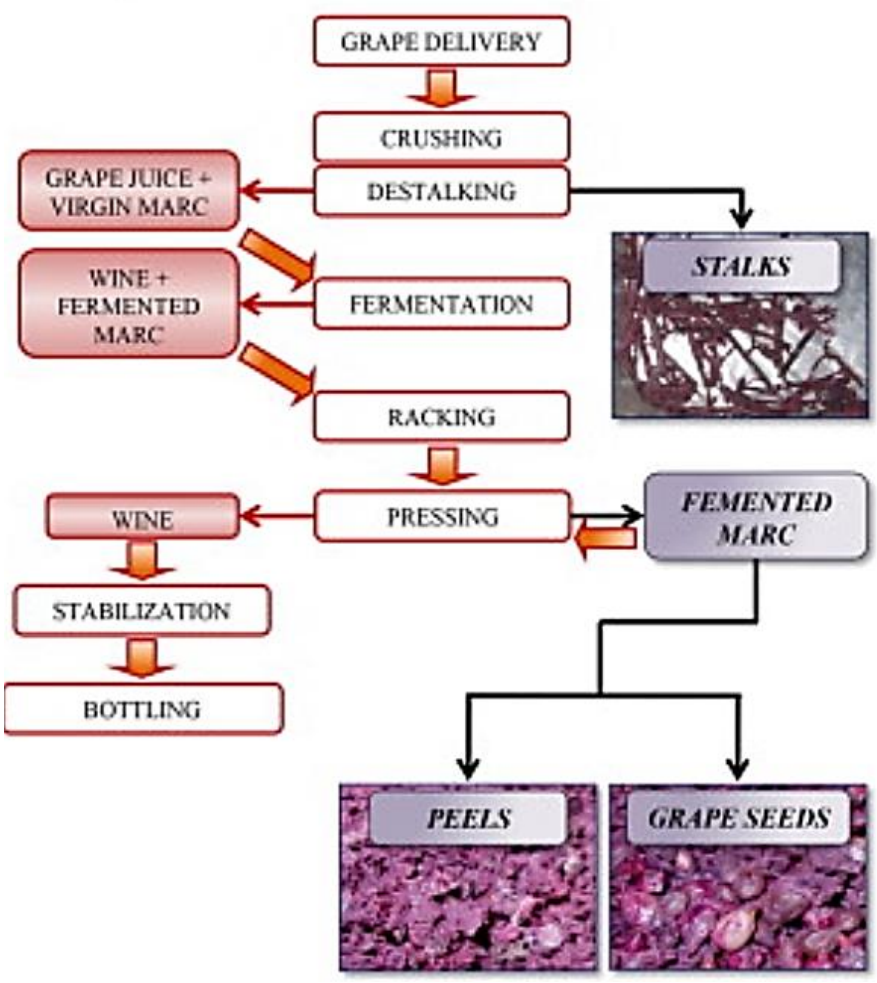


**Figure 5** Red wine production processes.[14]

Grapes fresh from the press are ready for consumption by cattle immediately. However, pressed grapes do not store well in silos due to continuous fermentation and therefore should be dried or refrigerated for longer shelf life. Grape seeds are not chewed up by cattle but may provide beneficial oils or pass out in the manure undigested.

Another source of the grape byproduct is from the distilled spirit industry where grapes are compressed into a concrete or plastic vessel and allowed to ferment a second time. Afterward the spent grape marc is dried and ground into a powder. The grape marc powder is mixed with other forage ingredients and turned into a pellet.

**Video Presentation: Grape Marc Processing**

Video 1 Grape marc storage, Pedro Carvalho.

Video 2 Large Grape marc dryer, Pedro Carvalho.

Video 3 1 ton pomace separator, marc separator. Separates grape seed from grape skin, Onmak Makina.

## Grape Marc Storage

Food waste left in unrefrigerated containers for 24 hours produces offensive odors and goes completely moldy within three days. If grape marc is allowed to spontaneously ferment at 36 degrees Celsius (96° F) up to 1,800 mg per 100 ml of methanol is formed. In comparison, grape marc at 15 degrees Celsius (59° F) can produce up to 650 mg per 100 ml of methanol. Methanol is a highly toxic substance than can cause nerve damage and blindness.[6] Short term storage of grape marc is conducted by mixing in a lactic acid bacteria culture medium daily to keep it preserved and odorless for more than a week.[13]

Grapes can be stored in a refrigerated compartment for 2 to 3 months, depending on a variety of factors. A temperature of 0 degrees Celsius (32° F) allows for optimum storage. The temperature of the grape marc is an important variable; for example storing the material at 8 degrees Celsius (46° F) will reduce longevity by as much as 70%.[2]

## Mechanical drying

One popular method of preserving grape marc is oven drying at 70 degrees Celsius (158° F) for 48 hours.[10] Grape marc that is heated to 60 degrees Celsius (140° F) are soft and flexible while retaining a reddish-purple color (Figure 7). Grapes dried at a higher temperature of 90 to 100 degrees Celsius (212° F) are dark, stiff and fragile .[9] Rotary drum dryers are a common method used. Heat pump drying reduces energy consumption since the hot air is reused within the chamber. The heat pump system removes the moisture in the chamber by using a condenser instead of venting to the open air.[11] For individuals that do not have access to drying equipment the use of rejected raisins and stems may be alternative.[1]

## Biodrying

Biodrying provides a highly controlled aerobic environment for the grape marc that discourages spoilage while cultivating bacteria that generate enough heat to dry the material. The most important parameters are oxygen, airflow and temperature. A bulking agent is mixed with the grape marc so that air can easily pass through the material and heat is evenly distributed throughout; an example is straw or hay.[4] The process is often paired with a mechanically supported airflow. Leachate from the material is collected through the holes in the bottom of the device.[3] A 100-mm high

layer of 5 mm ceramic balls covered with a 2 mm screen mesh are placed on the bottom of the reactor for uniform air distribution and effective leachate collection (Figure 8).[12]

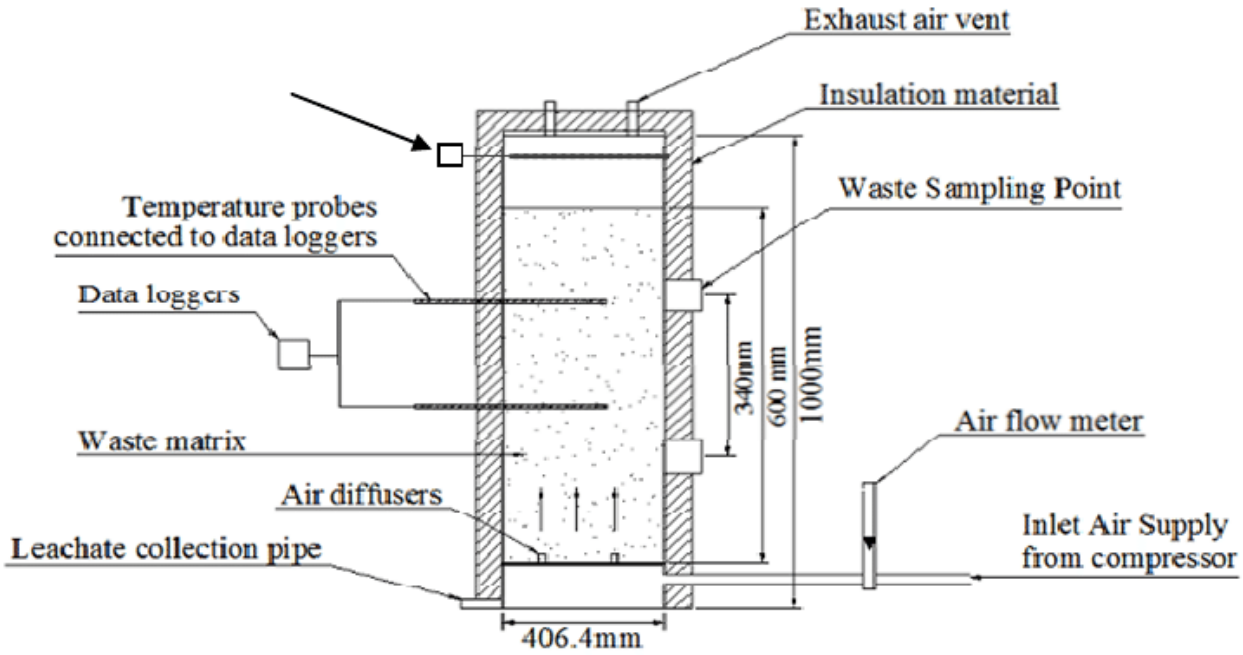


**Figure 6** Schematic diagram of a small biodrying reactor.[12]

**Coatings**

After grape marc is dried, an edible coating can be applied to prevent the degradation of the nutritional components. Most bacterial growth is prevented by keeping the water activity level below 0.90. However, yeasts and molds can grow at low water activity levels. When the pH of a product is not below 5.0 it is necessary to take additional steps to preserve food items against bacteria such as *Staphylococcus aureus.* Coatings can include additives that increase the food quality, stability and safety.[11] This is also done in areas with sufficient humidity to rehydrate the grape marc.

There are various types of coatings depending on the needs of the user. They can be composed of proteins, polysaccharides or lipids. A good example of a coating material is pectin which reduces bacterial contamination and prevents the dried grape product from sticking together.[5] Corn zein, an extracted protein, acts as a second skin resulting in increased

gloss, mechanical strength, as well as an effective moisture barrier.[7] Dipping is the most favored method by farmers to coat uneven dried fruits such as raisins.[9] This process is used for long term storage of grape marc.

The process is essentially:[5]

- Prepare the coating solution
- Dip the dried fruit in solution for 2 to 3 minutes
- Shake the dried fruit for 4 to 5 minutes to remove excess solution
- Dry the coated product at 10 to 15 degrees Celsius ($50^0$ to $59^0$ F) for 7 to 8 hours
- Package the coated product in polyethylene bags
- Store in dark room at 20 to 25 degrees Celsius ($68^0$ to $77^0$ F)

## Summary

One of the production issues for viticulture industry is the disposal of the grape byproducts that are left after they make wine or distilled beverages. Usually the approximately 523,000 metric tons of pressed grapes go to the local landfill to rot. Also, the raisin industry has an abundance of stems and rejected dried grapes that may serve as a source of cattle feed.

Short Sheep Micro-Winery and Flyfaire Wines have been operating with this practice for years. Both of these companies exist in Australia where a long drought season raises the cost of animal feed. The byproducts of wine production, frequently called grape marc, are fed to the cattle as part of their balanced food ration.

Grape marc has several benefits as a cattle feed such as reducing the occurrence of foamy bloat due to the tannins and beneficial oils found in grape marc. The use of grape pomace as cattle feed supplement would result in less food waste that would otherwise be shipped to the landfill. The processing of grape marc into cattle feed would result in a useable, economic product for both the cattle and grape industries.

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