Destemming

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In this essay the process of destemming is discussed as well as the advantages and consequences of using this winemaking technique. In order to understand the purpose of destemming one must understand the structure of the grape bunch and the characters imparted by the stems at different stages of maturity. It is important to note the sensory characteristics which result from fermentation without stems. The various regions where this technique is commonly used are discussed.

Destemming, also known as destalking, can be defined as the process where the stalks are removed from the whole berry clusters. The process is referred to as *égrappage* or *éraflage* in French. Generally immediately after being destemmed the grape berries are crushed and alcoholic fermentation may take place. In the past, wines were made without stem removal or crushing processes. However, today the majority of red grapes are destemmed.

The use of a destemmer is a fast, economical way of separating the stems from the berries. Destemming may occur through the use of the destemmer at a winery or in the vineyard by a machine harvester. Before the development of destemmers, the only way to destem grapes was to manually remove the berries from the stems. It is however an extremely expensive, time-consuming process, which is only executed by a few cellars today. Some examples include: Château Pape Clément in Bordeaux, Domaine de la Vougeraie in Burgundy and Lapostolle in Chile. (Robinson et al., n.d.)

The destemming of grapes has become standard cellar practice due to the development of destemmers. Destemming machines consist of a steel perforated cylinder and shaft which is placed inside the cylinder. On the shaft are paddle-like arms. As the shaft rotates, it pulls in the grape clusters and the berries are removed from the stalks by the moving paddle-like arms. The berries move out through the perforations in the cylinder and the stalks stay behind. Due to the continuous rotating movement of the shaft, grape bunches are drawn in and stalks will exit the machine from the opposite end. (Jackson, 2014)

To fully understand why stems should or should not be used in fermentation, one must understand the structure of the grape bunch or cluster. Each grape berry is attached to a pedicel which connects them to the rachis or stalk. This structure including the grape berries and rachis is referred to as a cluster. The length of the pedicels with determine the shape of the cluster. Shorter pedicels will result in compact bunches whereas longer pedicels will result in loose bunches. The rachis or stalk will represent 3 to 7% of the weight of a ripe grape cluster.

In terms of chemical composition, the stalk has a low sugar concentration and a moderate acid concentration. The acids are in the form of salts due to the large amount of cations present. Stalks have a high concentration of phenolic compounds, approximately 20% of the total phenolic compound concentration of the grape cluster.

During the ripening process the stalk will also undergo a series of changes. The unripe stalk will be green in colour and develop into brown, ripe stem with maturation. Further development can occur from ripe stems to overripe stems which will have a brittle character. Vegetal or leafy characteristics are associated with green stems. Characteristics associated with ripe stems include: resinous wood, spice, cloves, cinnamon, pepper. Dried leaf and tea characteristics are associated with overripe stems.

There are many advantages regarding destemming. Once grapes are destemmed the tank capacity needed is reduced by 30%. In this way, destemming provides a financial advantage. It may be beneficial to limit the uptake of phenolics in certain cultivars, such as Cabernet Sauvignon, where the phenolic content of the wine will already be fairly high due to the large skin to juice ratio. The phenolics extracted from stems include: catechins, flavonols (especially quercetin) and caftaric acid. Also fermentations, involving grapes which have been destemmed, result in less grape matter to be pressed which save both time and energy. Destemming will result in wines with greater colour intensity. This is due to the fact that anthocyanins are adsorbed on the ligneous surface of the stems. Destemming may increase wine quality as there will be no disagreeable astringent or vegetal characters imparted by the stems. (Jackson, 2014)

There are numerous consequences to destemming grapes prior to fermentation. Fermentations without stems take longer to begin as significantly less air is captured within the cap. An increased number of channels prevents the temperature from rapidly climbing, however once grapes are destemmed there may be a risk of temperatures rapidly increasing during fermentation. These factors increase the risk of difficulties during fermentation.

The stems will modify the wine composition, therefore destemming results in wine with higher acidity and alcohol content. This is due to the fact that the stems contain water and are rich in potassium. Destemming prevents the addition of water from the stems which will dilute the alcohol of the wine and it will prevent potassium from being secreted which would otherwise lower the acidity.

Destemming significantly affects the tannin concentration of the wine. There will be less tannin imparted from the grapes to wine in instances where the grapes have been destemmed. The stems release significant concentrations of phenolic compounds and tannins into the wine during fermentation and pressing. This decreased tannin concentration may lower the quality of the wine as it may lack structure without the addition of the stems. Tannins also increase a wines ageing potential. (Stemming the Tide - World Of Fine Wine, 2020)

Destemming grapes which have been infected with Botrytis cinerea results in greater concentrations of the oxidation enzyme laccase. The presence of stems causes the laccase activity of Botrytis cinerea to be inhibited. More equipment is needed to process grapes that undergo destemming. This equipment must also be sufficiently cleaned which uses more time and requires labour. (Jackson, 2014)

The major sensory differences between wines produced from destemmed grapes and wines produced by whole bunch fermentation are associated with phenolic profiles and wine aroma. During the early stages of whole bunch fermentation some carbonic maceration may occur and this will impart very particular characteristics. Carbonic maceration imparts unique flavours including ‘fruity’ or ‘spicy’ aromas. This is not the case for destemming. Stem removal will prevent the development of green ‘cut grass’ or ‘herbal’ aromas in the wine as these are characters that can be attributed to the use of stems. The addition of stems increases fruit and floral aromas. Wines that have been produced from grapes which have been destemmed have lower tannin concentrations. Wines produced by whole bunch fermentation may have excessive tannin content and this may lead to astringency in the wine. In instances where stems are not removed, the wines may be described as having ‘dark red’ and ‘purple fruit’. When the stems are not removed the wine may be described as having ‘red fruit’ and herbaceous characters. This can be attributed to the high levels of methoxypyrazines found in unripe stems. Visually wines without stems have a far better colour intensity as the stems are responsible for removing a small amount of colour.

The phenolic content of whole bunch fermented wines is significantly higher compared to wines without stems. The polymeric anthocyanin content is also much higher in whole bunch fermented wines and lower in wines where grapes underwent destemming. This is due to the polymerisation of pigments with phenolic fractions from the stems. (Spotlight on whole-bunch fermentation, 2020)

Greenness is one problem that is most associated with stems. Even though the use of stems is increasing in popularity it will never be used in the region of **Bordeaux**. This is due to the similarities of some of the varieties cultivated. Cabernet Sauvignon, Cabernet Franc and Merlot all have varying levels of methoxypyrazines, giving the wines a green character especially if the grapes are picked too early. This green character may be especially prevalent in cooler climate regions such as Bordeaux. The use of stems on theses cultivars could risk exaggerating green flavours already present therefore destemming in Bordeaux has become standard procedure.

In **California**, producers also avoid the use of stems with the Bordeaux varieties such as Cabernet Sauvignon. They are sensitive to any green character being preset in the grapes and wine. Therefore the use of stems is viewed as extremely risky. There is also sufficient tannins present in the Cabernet Sauvignon and the stems are not needed to add additional tannin or increase the phenolic concentration. California producers also do not generally use stems with Zinfandel. It is equally as tannic as Cabernet Sauvignon and therefore does not require any additional structure. (Stemming the Tide - World Of Fine Wine, 2020)

In the **Douro Valley of Portugal** the grapes are destemmed followed by crushing in the production of Port. The destemming and crushing of the grapes allows for the rapid development of colour. No colour is lost due to adsorption by the stems. It is crucial that no colour is lost because the fermentation process is shortened as spirits is added to halt the fermentation once a specific sugar concentration has been reached. Also because the fermentation has been shortened extraction in the form of punch downs must happen extremely regularly to extract sufficient tannin and colour before the fermentation is stopped. This will result in extremely green, harsh and astringent characters being present in the wine as a result of the use of stems. (How Port is Made and Why It's Amazing | Wine Folly, 2020)

In most of the regions of **Chile** destemming grapes is common practice. This is especially prevalent in areas where mostly Cabernet Sauvignon and Merlot are cultivated. As previously mentioned, this is associated with the risk of producing a wine with dominating undesirable green or herbaceous flavours. Powerful and robust wines with high tannin concentrations are produced. To produce such a powerful wine, there must be fairly high extraction taking place during fermentation. This will increase the risk of extracting astringent tannins from the stems and undesirable vegetal characters. For these same reasons, the majority regions of **Argentina** will destem their grapes. Powerful, tannic wines are produced predominantly from the Malbec grape. Due to this wine style being produced and the level of extraction therefore required makes destemming grapes the most favourable technique to use. (Why Chile — Cultivar Fine Wines, 2020)

In conclusion, the decision to destem is determined by several factors. These include: climatic conditions, cultivar and wine style produced. In cooler climatic conditions stems are usually underripe and green and certain varieties will have increased levels of methoxypyrazines due to the cooler conditions. As a result grapes should undergo destemming to prevent the development of green characters in the wine. Specific varieties such as Cabernet Sauvignon have higher levels of methoxypyrazines naturally present and therefore should be destemmed. Destemming should take place when certain wine styles are being produced. For example: powerful, tannic wines and port. This is due to the high level of extraction which must take place and this will extract undesirable flavours from the stems.

Wholebunch Fermentation

The following essay discusses the winemaking technique: whole bunch fermentation. The advantages and disadvantages of this method are discussed as well as various countries who are known to incorporate this technique. Whole bunch fermentation is also differentiated from carbonic maceration.

The process of whole bunch fermentation is a traditional method of red wine fermentation where the grape berries do not undergo destemming. Whole clusters are used for fermentation. This method generally involves some slight carbonic maceration especially in the early stages of fermentation. The popularity for using whole bunch fermentation has increased. The trend currently being pursued by winemakers is to create fresh, elegant and complex wines. This differs from the powerful, structured and tannic wines favoured in the 90's and early 2000's. As a result winemaking techniques that encourage freshness and elegance, such as whole bunch fermentation, are being more frequently used. This is accompanied by the preference for neutral oak, concrete tanks and amphorae. (Robinson et al., n.d.)

Stems are present in the following two winemaking techniques: whole bunch fermentation and carbonic maceration. It is crucial that whole bunch fermentation is differentiated from carbonic maceration. In the case of carbonic maceration the whole bunches are kept under a blanket of carbon dioxide for approximately one week, after which the berries will be broken and fermentation will proceed. During carbonic maceration enzymatic reactions occur within the berries resulting in the formation of unique flavour compounds such as benzaldehyde (cherry, almond), vinyl benzene (plastic) and ethyl cinnamate (strawberry, cinnamon). (Stemming the Tide - World Of Fine Wine, 2020)

If using whole bunch fermentation it is crucial to determine the maturity level of the stems to be used. Unripe stems consist of green photosynthetic material. During the ripening process stem begin to lignify. this involves the transition of unripe, green fleshy stems to ripe, woody stems and finally overripe brittle stems. This occurs as lignin is deposited in the in the spaces of the cell walls. The most well-lignified stems will most likely be found in parts of the vineyard with lower vigour as lignification occurs when shoot growth stops. There will likely be less instances of lignification in vineyards with high vigour as shoot growth is constantly stimulated. There will also be less lignification in wet years and in areas with cooler climates because water and humidity will stimulate shoot growth.

The most common way to incorporate a percentage of whole bunches in a fermentation is to place the whole bunches in the bottom of the fermenter and place the crushed and destemmed berries on top. However, there are winemakers who prefer to place the whole bunches on top of the crushed berries as this allows for the berries to remain whole for a longer period of time. It is also to monitor extraction from the skins greater extraction occurs when the stems are fully submerged. As the fermentation progresses an increasing amount of berries will be crushed as punch downs commence.

If 100% of the grapes are being whole bunch fermented there should still be some juice in the bottom of the fermenter. As this starts to ferment, either by inoculation or spontaneously, the released carbon dioxide will protect the remaining fruit from oxidation until fermentation fully begins. (Stemming the Tide - World Of Fine Wine, 2020)

The effect of the stems on the resulting wine will vary depending on the ripeness of the stems. The chemical composition of the wine as well as the flavour profile will be altered due to the usage of stems. The use of stems will also have physical impact on the wine. There are many benefits to using stems in fermentations. The stems allow for the easier drainage of the juice through the cap. This allows for punch downs or pump overs to be performed more easily. (Understanding whole-bunch fermentation, 2020)

Stems aerate the cap and allow some heat to escape and it therefore remains slightly cooler by one or two degrees. Although this sounds insignificant it can have a large impact on the wine after alcoholic fermentation. Water contained within the stems is released into the ferment which slightly lowers the alcohol level. This can be beneficial in warmer vintages where the fruit is harvested riper resulting in alcohol levels which are higher than normal. (Stemming the Tide - World Of Fine Wine, 2020)

The presence of stems allows for the easier movement of yeasts. As yeasts are able to move more easily within the fermentation more sugars are consumed more quickly. This results in a quick and complete fermentation with no threat of slow or sluggish fermentation.

The use of stems increases the supply of long chain unsaturated fatty acids. This is extremely beneficial to yeasts and will improve their ability to survive in cool cellar conditions. It will also promote a quick and complete fermentation. (Jackson, 2014)

The stems also decrease the negative effects of fungus such as Botrytis cinerea which may be present on grapes. The presence of stems results in the oxidation enzyme laccase, produced by Botrytis cinerea, to be inhibited. This ultimately results in wines less flawed by rot compared to wines which were made from deterred grapes. Producers who use the method of whole bunch fermentation claim that this technique imparts organoleptic benefits such a firmer tannins, increased aroma, freshness, elegance and complexity. (Robinson et al., n.d.)

Using the technique of whole bunch fermentation has several disadvantages. Unless the stems are ripe or lignified and the must is handled very gently, the stems may impart harsh tannins to the wine. The stems are likely to be poorly lignified in areas with cooler climates or in wet vintages.

This technique also involves a greater total capacity of fermentation vessels, which must most likely be open to allow for punching down or pumping over. In the early stages of fermentation it can be extremely difficult to break the clusters and they may have to be broken by foot. This is a more time consuming and labour intensive process. The stems must be extremely clean and have no trace of mould or else this can greatly increase the level of volatile acidity of the wine. Mouldy stems will also result in a wine with extremely negative flavour and aroma profiles. In instances where the stems are unripe, bitter, green or vegetal characters my be present in the wine. This is a result of the methods used to extract sufficient colour and tannin.

Potassium present in the stems is leached into the must during fermentation. It combines with tartaric acid present and then precipitates acid out of the wine. The acidity is therefore lowered and the pH increases. An increase in pH can be detrimental as it creates a more favourable environment for unwanted micro-organisms. Whole bunch fermentation results in a wine with a lowered colour intensity compared to a wine where the grapes were destemmed. This is due to colour pigments being adsorbed onto the stems. (Stemming the Tide - World Of Fine Wine, 2020)

Grapes must be hand harvested in crates as a machine harvester will damage the bunches. More time and effort is required to gently transfer the grapes from the crates to a suitable fermentation vessel. (Winemaking with stems - Wineland Magazine, 2020)

Whole bunch fermentation is most common in **Burgundy** and proves very successful on the cultivar Pinot Noir. Wines made from Pinot Noir usually have low tannin concentrations however this can be increased through the use of stems as tannin is leached from the stems into the must. This will increase the structure and ageing potential of the wine. Cabernet Sauvignon is generally unsuited to this technique due to the risk of increasing green flavours which may already be present especially in cooler regions There is also no lack of tannin in Cabernet Sauvignon skins. The famous Burgundian domaines who use whole bunch fermentation include: Domaine de la Romanée Conti, Domaine Leroy, Domaine Dujac and Domaine Ponsot. In Burgundy the use of stems has been increasing in popularity. This is due to two main reasons: Firstly the passing of the influential grower Henri Jayer in 2006, who was extremely opposed to the use of stems and encouraged destemming across the region. Secondly, climate change is allowing stems to ripen and therefore ridding them of astringent green characters which may have been imparted to the wine. The producers feel that it is an extremely beneficial technique. In cooler vintages when acids are high the use of stems slightly lowers the wines acidity and in warmer vintages the stems add a freshness to the resulting wine. (Robinson et al., n.d.)

The technique of whole bunch fermentation is used by traditionalists in **Northern and Southern Rhône** to make elegant Syrah's. The tannin extracted from stems is finer, chalkier tannin provided that only sufficient punch downs or pump overs are performed and over extraction does not occur. This results in a finer more elegant wine compared to the coarse tannin which is extracted from grapes which have been destemmed and crushed. For this reason whole bunch fermentation is also favoured by producers in **Swartland, South Africa**. This region has taken inspiration from Southern Rhône with regards to the cultivars planted and the winemaking techniques used. It is therefore not surprising that whole bunch fermentation is favoured. Due to the extremely warm climatic conditions of the Swartland, the fruit ripens quickly. It can therefore be extremely beneficial to retain the stems during fermentation because they will add freshness and complexity to the wine as well as result in a wine with a slightly lowered alcohol concentration. (The quest to become whole again - Wineland Magazine, 2020)

Whole bunch fermentation is all favoured by many producers in **Australia**, particularly the Victoria region where the technique is used predominantly on Shiraz. It is used to add restraint and elegance to these particularly robust reds. More structure is also added as tannin leached from the stems into the must during fermentation.Whole bunch fermentation is often used in **Central Otago, New Zealand** on the Pinot Noir ferments. This is done according to the ripeness of the fruit as it is a cool climate region and care must be taken not to produce a wine with bitter, astringent, vegetal flavours. Another region where stems are used in ferments is the **Roussillon** region of France. Previously, over extracted and rustic red wines have been made in this region however due to the increasing popularity of whole bunch fermentation more elegant and less extracted wines are currently being produced.

In conclusion, ripe stems are extremely desirable as they will impart structure and complexity without imparting undesirable green characters. The climate of the vineyard determines how the stems ripen and therefore determines whether stems should be used or if grapes should be destemmed. Multiple factors are crucial when determining the percentage of whole bunch to use. This includes: the ripeness of the grapes, the degree of lignification of the stems and the presence of rot on the grapes. If the grapes are extremely ripe a greater percentage of whole bunch should be used as the stems will add freshness and vibrancy to the wine. If the stems are unripe a lower percentage of whole bunch should be used to prevent green characters from being imparted into the wine. Whole bunch is extremely successful on cultivars such as Pinot Noir and Syrah. It increases the tannins content and structure of Pinot Noir and adds complexity, vibrancy and elegance to wines made using this winemaking technique.

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