

Carbonic Maceration:

Modern version of a
neolithic wine?

For those of you who cannot remember what carbonic maceration is, it is **not** chewing on coal, or the below:



How about:

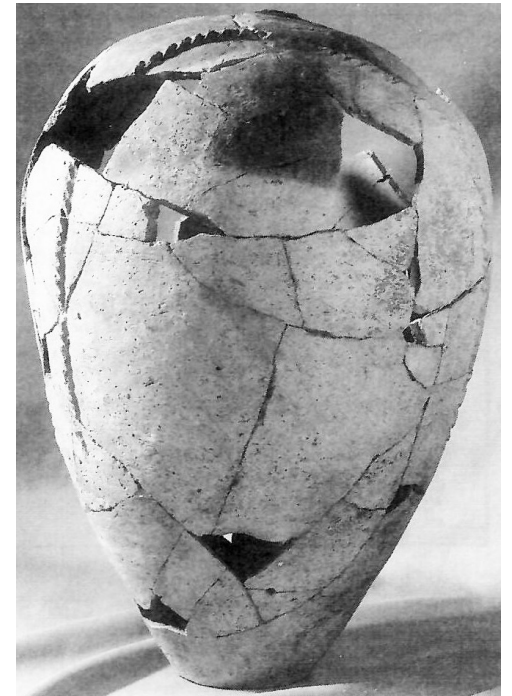
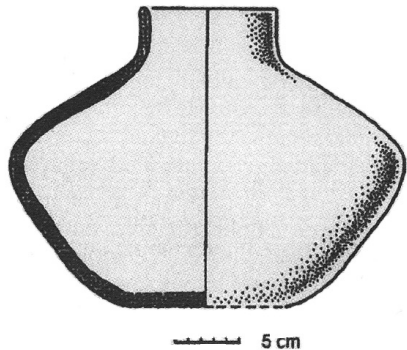
*Le Beaujolais
Nouveau est
arrivé*

- for those familiar with Beaujolais (and its baby brother, Beaujolais nouveau), you might wonder why discuss such a frivolous winemaking procedure
- self-respecting aficionados abhor this popular, infantile wine
- two reasons, other than I love the wine
- a faulty version that got me noted by the top brass of the MLCC, eventually leading to my being hired to assess the suitability of candidates for their tasting panel
- without that experience, would I have written *Wine Tasting: a Professional Handbook*?
- also, when writing *Wine Science: Principles and Practice*, I needed topics no other technical treatise discussed
- carbonic maceration, maybe because the literature was in French (and Italian) was my chance
- the same rationale induced me to delve into amarone production

But before getting into how Beaujolais and similar wines are associated with carbonic maceration, let's think about the second part of the title:

Modern Version of a Neolithic Wine

- jet back ~9,000 years to Anatolia, Turkey, the presumed site of wine's origin.
- you have developed the ability to produce ceramic pottery like the following vessels.



- your wife has had a field day, and collected more wild grapes than you can eat, vessel being handy, you store them in it
- being diverted, a lion has sited and you are off to obtain a Tarzan loincloth rather than become supper
- being a hot fall, during your sojourn hunting, the grapes begin to self-ferment
- in the joy of your safe return, the pot of fruit continues to be forgotten
- finally, an seraphic odor permeates your humble abode, and found to emanate from the pot
- the grapes being somewhat mushy, attempting to pour the contents out produces a fluid
- quick action finds a cup, and upon sampling you cry out “Eureka! Neolithic wine.”
- *ipso facto*, the beau-joly of life called wine is borne.

Albeit fictitious, beaujolais wines are made in a manner crudely resembling how wines may have been first made.

- made from grape clusters
- piled into a broad, shallow fermentors
- covered with a wood or plastic
- left to suffocate, intact fruit begins to autoferment (mostly in a CO₂ atmosphere), others in free juice in which yeasts begin to ferment
- slowed release of CO₂ and cooling temperature signal its end
- the now flaccid grapes are easy to crush
- fermentation comes to a quick conclusion
- the free-run wine is collected separate from the press-run fractions
- each is bottled separately or partially blended, depending on the style desired

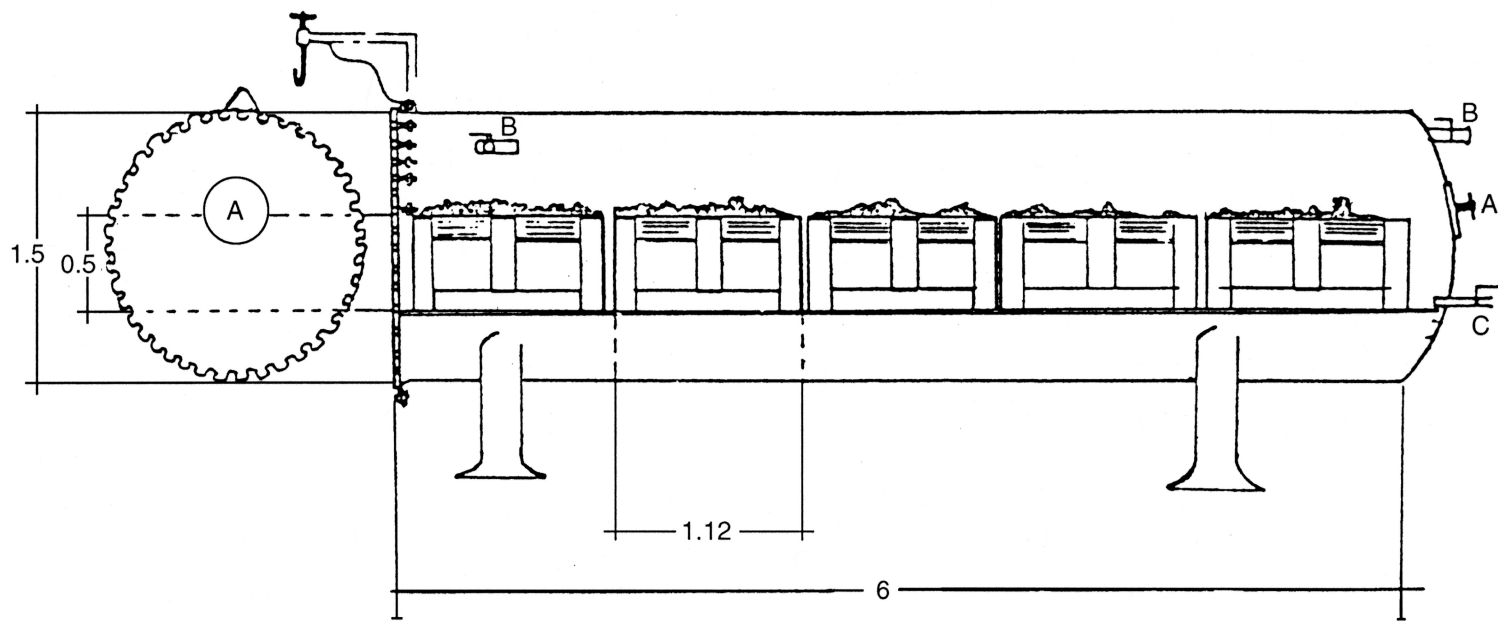




- beaujolais is not strictly a carbonic maceration wine, being more semi-carbonic maceration.
- the principal differences are that grape autofermentation:
 - commences and may occur in the absence of released juice; the piled grape clusters are flushed with CO₂; occurs at >30 °C.
- the technique was developed by Michael Flanzy in 1932 (France). -
- the original intent was to prolong grape storage (in a manner similar to that used to store apples— under a blanket of CO₂
- however, the grapes began to ferment, producing ~1.5–2% alcohol
- unique flavorants were created, and upon crushing and yeast fermentation, the wine was smoother, more harmonious, and enjoyable than using traditional procedures
- the process was dubbed “*macération carbonique*”

- although the process as proposed was new, the use of a simpler (semi-) carbonic maceration is old
- before modern crushers became common, a variable % of grapes remained whole and would have undergone berry-fermentation
- Pasteur recognized it as common (‘... *tout le monde sait* ...’) and recommended its investigation in 1872
- the preference for having part (or all) of the harvest commence fermentation uncrushed is noted by Henderson, 1824, Cocks, 1846, Thurdichum and Dupré, 1872 and Guyot, 1861
- the wines were considered more delicate in flavor and lighter in color
- its use has remained standard in Beaujolais, and is (or was) used in Rioja (in *vinaria*), Italy (Barolo and Barbaresco), and Georgia (in *kvevri*, mostly buried in the ground)
- carbonic maceration is now used in Italy (*vino novello*), and to a limited degree in Canada, the United States and Australia.

- in Beaujolais, harvesting the clusters by hand often occurs in the heat of the day (so the grape are warm when added to the fermentor)
- fermentation often commences at about 22 °C
- CO₂ flushing is uncommon, resulting in a slower start and longer duration of autofermentation (up to 2 weeks)
- as some grapes break during vat loading, while others rupture during autofermentation, yeast fermentation occurs simultaneously in the accumulating juice
- it may be drawn off periodically, and pumped over the remaining fruit (causing more berry rupture)
- a yeast inoculum and limited SO₂ may be added
- in Italy, the grapes are placed (as harvested) in specialized tanks, flushed with CO₂, and the tank sealed
- thus, *vino novello* production is closer to pure carbonic maceration
- in Australia, boxes of grapes may simply be rapped in plastic film



- carbonic macerations not only generates a fresh fruity aroma, but it may accentuate the varietal character of the cultivar used (e.g., Shiraz and Muscat), provide character to varieties that are aromatically neutral (e.g., Caragnan and Gamay), supplement flavors (e.g., Marechal Foch), or suppress (mask?) the distinctiveness of others (e.g., Concord, some French hybrids, Muscadine grapes)
- the proportion of the grapes needing to undergo the process to noticeably affect the sensory character of the wine can vary markedly (from ~20 to 85%, as in the case with Cabernet Sauvignon)
- when the free-run wine is bottled separately, it is ready to drink early (~2–3 months), but loses its character quickly (e.g., *beaujolais nouveau*, *vino novello*)—supposedly due to the cooler autofermentation
- when the press-run and some free-run is blended, the wine matures more slowly, but also has a longer shelf-life (e.g., regular Beaujolais and cru Beaujolais).

	Full carbonic maceration	Semicarbonic maceration (Beaujolais)
Visual appearance	Ruby red	Ruby red
Fragrance	Kirsch Coffee English candy Vanilla Grilled almonds Russian leather Resin	Hyacinth Coffee English candy Vanilla Cherry Banana Raspberry
Quality	Fine (predominantly vegetal and lactic)	Rich (predominantly winy and phenolic)
Taste	Subtle Buttery	Rough Tannic

chemical indicators
of carbonic
maceration: ethyl
cinnamate, ethyl 9-
decenoate,
benzaldehyde,
isoamyl acetate

^a After Flanzy *et al.* © INRA, Paris (1987), reproduced by permission.

Advantages:

- early drinkability (even quaffability) of the version based on the free run—leading to a quick return on investment
- novel fruity character, reduced herbaceous character
- may enhance (or reduce) desirable (undesirable) varietal aromas
- smoother taste (lower acidity and astringency)
- grapes can be harvested during the heat of the day and easier crushing

Disadvantages:

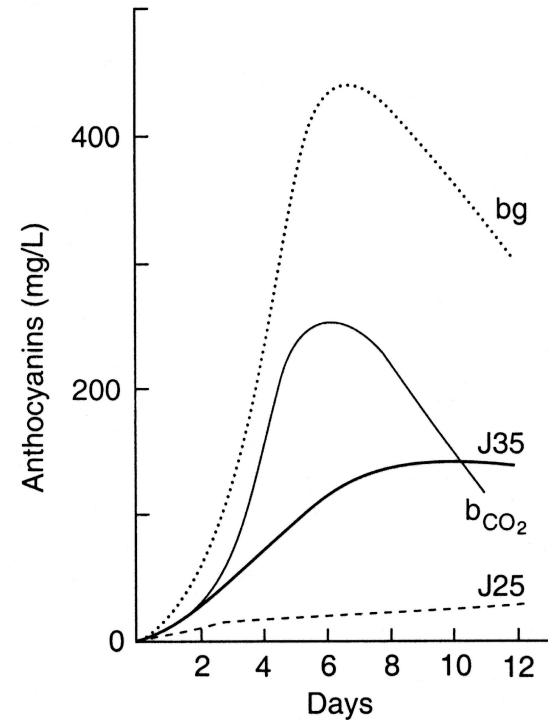
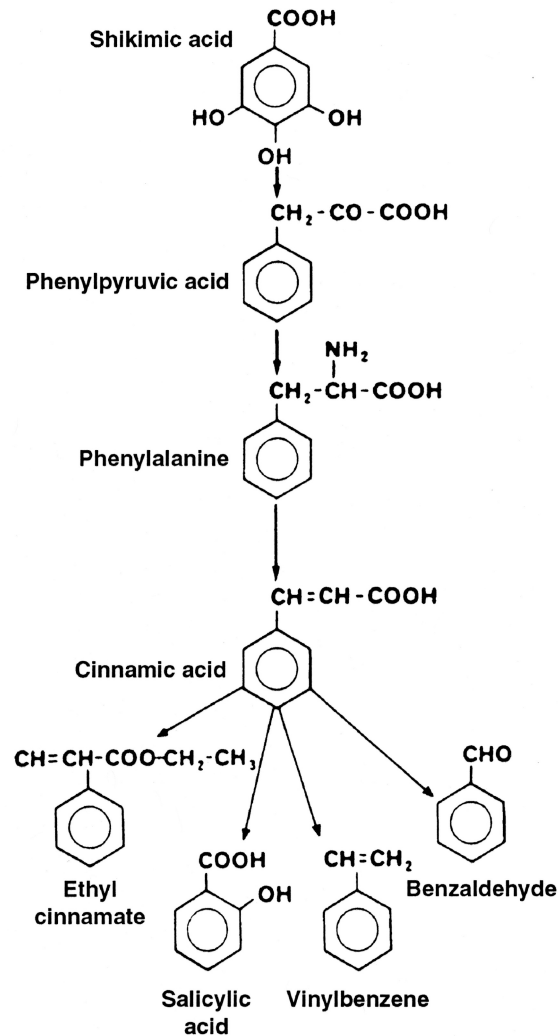
- expense of manual harvest and special, supplemental fermentation tanks that are ill-designed for loading and unloading
- longer total fermentation time
- short shelf-life (6–12 m) of the *nouveau/novello* version
- lower price (frivolous image/absence of long-aging potential)

Details:

Phase 1: Autofermentation

- CO₂ is preferred flushing gas as it is heavier than air, eliminates oxygen (speeding the end of respiratory metabolism), readily dissolved in the cytoplasm, induces ion leakage, activates pectic enzymes (weakening the grape structure), modifies secondary metabolism
- grape fermentation is similar to yeast fermentation (alcohol being the main by-product), but also enhances the metabolism of other acids (e.g., malic, oxaloacetic, pyruvic and succinic acids)
- the accumulating alcohol disrupts membrane function, releasing organic acids stored in vacuoles, eventually lowering the cytoplasmic pH, inactivating most enzymes, resulting in cell death
- changes in the shikimic acid pathway generates volatiles (e.g., ethyl cinnamate, benzaldehyde, guaiacols, vinyl phenols) and indirectly a range of aromatic ethyl esters (e.g., ethyl cinnamate)

Shikimic acid
as a precursor
for aromatic
compounds.



Anthocyanin release in:
 - free-run must (J) at 25 vs 35 °C
 - grapes immersed in juice (bg)
 or only in CO₂ (bCO₂)

Fermentation of Released Juice

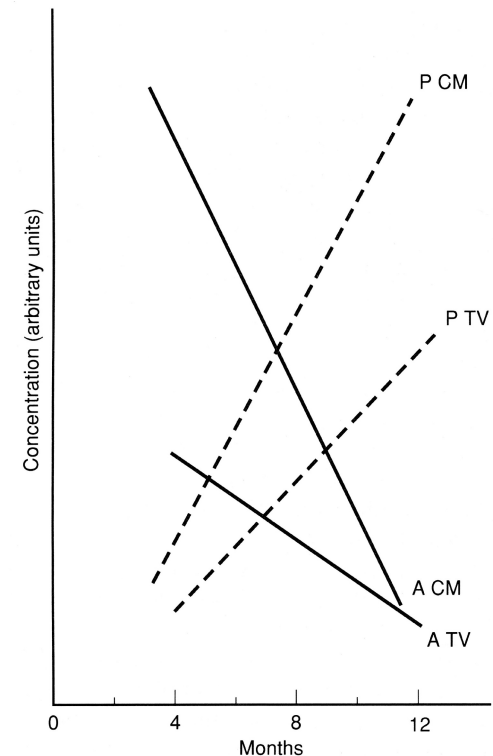
- varies from negligible (full-form) to progressive (semi-form)
 - fermentors (~ 2.5 m deep) limits it in Beaujolais (~10–20%), rising to 35–55% by the end of autofermentation (pumping over)
 - minimal SO₂ to limit H₂S and facilitate malolactic fermentation
 - yeast action speeds CO₂ and heat accumulation, enhances anthocyanin and flavorants extraction from intact, submerged grapes
 - the principal fermentor is *Saccharomyces cerevisiae*, with up to 25% *Schizosaccharomyces pombe*
- at the end of autofermentation, the free-run is collected and the pomace pressed to get the press-run juice (1.5–2% alcohol)

Alcoholic Fermentation

- the free- and press-run fractions may be combined (if no malolactic fermentation is detected) and intended for a standard and cru beaujolais, but fermented separately if a *nouveau* is desired
- the juice may need to be cooled for fermentation to occur at standard temperatures (18–20 °C), completing is about 48 h
- in addition to generating alcohol, the yeasts alter the phenolic compounds produced during autofermentation (e.g., vinyl phenols increase and ethyl phenols decrease)
- malolactic fermentation usually occurs quickly, facilitating early fining and the bottling of *nouveau* versions
- a variable blend of free-and press-run wines is used to make the *nouveau* style, standard styles are primarily press-run-based wines.
- this is not a concern for *novellos* – having minimal free-run

Maturation/Aging Potential

- most *nouveau/novello* carbonic maceration wines are produced for rapid consumption, with almost no typical maturation period
- filtered and bottle shortly after malolactic fermentation
- aroma changes are somewhat similar but occur more quickly
- subjectively, the typical fruity aroma soon fades
- maturation of standard versions in oak is uncommon
- most versions are based on red grapes but a few white and rosé nouveau wines are produce



Development of aromatic compounds during maturation. A, isoamyl acetate and benzaldehyde; CM, carbonic maceration; P, volatile phenols; TV, traditional vinification.

As Mark Twain once said:

“The brain can absorb no more than the seat can withstand.”

Thus, to avoid the horrible death of:

“being talked to death”

We are at:

The End!

