Written by
Guest contributor
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Research reveals how hot bulk wine gets

Washington resident Gary Werner, who worked in wine publishing in the UK originally, reports on a worrying report.

Wine professionals and avid amateurs alike understand that temperature control is crucial to quality. Excessive heat can ruin a refreshing Riesling or compromise a captivating Cabernet. As a result, wine production facilities are noticeably chilly, and devoted oenophiles demand cool storage for their better bottles. But what happens during transit between producer and consumer?

This question is worth asking since more wine is being shipped vast distances. According to the 2016 annual report of the German Wine Institute (DWI), the share of global wine production that

is exported has expanded dramatically during the past three decades – from just 16% in 1990 to 42% by 2015. Facilitating this international trade, a growing portion of exported wine (now 38%, DWI) is shipped in bulk containers and then bottled at destination rather than at origin. Without glass and associated packing materials, a standard shipping container can carry more than double the volume of wine – with significant cost and carbon-emissions savings.

The export journey is frequently a long one – as many as nine weeks – and the climatic conditions in equatorial sea lanes and low-latitude land routes can be extreme. So, what happens to that well-travelled wine? Oddly enough, there is little formal, scientific research into the impact of temperature fluctuations on wine during transport (although see my 2008 article What happens to your wine en route – JR). Such a dearth of data recently inspired Dr Dominik Durner and his team at Weincampus Neustadt, a viticulture and oenology centre operated jointly by three German universities, to conduct a commercial-scale study.

'When looking at other food industries, quality control does not end when the product leaves its production site', said Durner. 'Dairy or soda companies, for example, have strict specifications for their shipping partners to make sure that consumers get top quality. So why don't we seek more control over wine logistics? Some of my colleagues and I believe it is time to do so.'

Durner and his team monitored three shipments of Chardonnay from Adelaide in South Australia to Duisberg in Germany. (The most common extended journey of wine in bulk is from the southern to the northern hemisphere.) The journeys took place between November 2015 and October 2016. They each lasted between 58 and 63 days, and 'transshipment' or in-port movement of the wine from one vessel to another occurred at Singapore and then at Rotterdam (onto inland barges for the final leg of the journey). Each shipment consisted of six containers, and each container held 24,000 litres of wine. Commercial wine shipments of this scale generally occur in flexitanks, which are massive synthetic bags. These, in turn, are stored inside conventional steel containers of the type hauled around motorways by articulated lorries or semi-tractor-trailer trucks. (See How wine travels nowadays – in bulk.)

To determine the impact of shipping conditions on this exported wine, Durner and his team installed temperature probes within the actual fluid (at a depth of one metre), as well as on the outer surface of each flexitank, and on the inner wall of each shipping container. Additionally, the wine in each of the three shipments was transported in three different container types: one-third of it within standard, uninsulated steel; one-third in steel containers lined with insulation such as polystyrene foam; and one-third within insulated cylinders known as Isotanks. Finally, the containers in each shipment were positioned at three different locations on the ships: one-third of them above deck, one-third below deck near the bow; and one-third below deck further aft.

Data from such a combination of variables should yield some potential answers to questions about the best season to ship wine across the globe, the best locations to position wine on ocean-going vessels, and the best container types to preserve wine quality. Of course, some sort of control wine is necessary for any chemical and sensorial (tasting) comparison; so Durner and his team air-shipped bottled samples to be evaluated alongside the wines shipped by sea. The control wines never exceeded 14 ºC (57 ºF) during their air shipment, and they were identical to those wines in each of the commercial containers.

Comparative analysis took place three weeks after the wine arrived by sea at the terminal. Alongside comprehensive chemical assessment, tasting was conducted in two rounds by a panel of 18 judges. 'They were a mixture of sommeliers, winemakers, and enology students', said

Durner. 'All received training on a variety of wine attributes before the evaluation sessions.'

What did they learn? Durner presented his research results at the national conference of the American Society for Enology and Viticulture near Seattle in late June. He explained to the audience of fellow scientists and commercial professionals that the conditions logged by the experiment's wine temperature probes varied wildly from 7 ºC (45 ºF) to 32 ºC (90 ºF). 'And as temperature increases, the chemical reactions behind wine ageing accelerate', he said. 'Also, the correlation between temperature and reaction speed is not linear – it's exponential. So in order to guarantee the full flavour experience that the winemaker intends for the consumer, shipping temperatures should not exceed 23 ºC (73 ºF).'

Unsurprisingly, the wines transported in standard (uninsulated) shipping containers suffered most when compared with the control wines. Their degradation took the form of deeper colour and more honeyed characters in aromas and flavours than in the air-freighted samples. The wines shipped by sea in well-insulated containers – such as the Isotanks – tracked between the air-shipped wines and the wines in standard sea containers in terms of these parameters. Additionally, altering the location of the wines on container ships correlated to a mean temperature difference of 5 ºC (9 ºF) over the duration of transit; and varying the season of shipping correlated to a 6 ºC (11 ºF) mean temperature difference.

What can the wine industry do with the results of this research? Durner said that timing such long-distance, trans-equatorial shipping around the spring or autumn equinox is generally better than doing so around the summer or winter solstice. In terms of location within the ocean-going vessel, Durner's experiment found that shipment above the waterline is best during the northern hemisphere's winter, while positioning the wine below waterline is better during winter in the southern hemisphere.

Dr Durner explains this thus: 'All containers accumulate heat during their journey toward equatorial waters. And the temperature gain on the way toward the Arabian Peninsula is similar for all locations on a vessel. However, northern winters offer a benefit to containers above waterline (on deck), in that they chill down again as soon as ships leave the Suez Canal. Containers stored below waterline do not benefit from this chilling effect.'

As regards container types, insulated Isotank cylinders or flexitanks within containers lined with polystyrene foam do notably more to preserve wine quality than do containers lined with other thermal liners such as foil or inflatable materials, and certainly more than uninsulated steel containers.

One final point highlighted by the research relates to transshipment – the movement of containers from one vessel to another in port. 'Time on the docks causes enormous warming', said Durner. 'I was shocked that wine is exposed to such high temperatures.' The extremes of direct sunlight and ambient temperatures up to 47 ºC (117 ºF) during this phase of transport drove the temperatures recorded in some wines to exceed a punishing 32 ºC (90 ºF). Durner said that for this reason, limiting or avoiding transshipment is vital to preserving wine quality. However, the commercial viability of doing so may be a significant hurdle.

Moving forward, Durner and his associates are continuing their research into wine logistics and the impact of temperature fluctuations. 'Some experiments include looking at the influence of shaking wine at different temperatures', he said, 'because the motion of shipment speeds up the chemistry of wine development.' As well, Durner said, 'We are working on new insulation materials to lower peak temperatures in transit. These materials need to be cheap, easy to

recycle, and environmentally friendly. So it's not an easy objective.'