Temperature Patterns along International Wine Supply Chains and their Effects on Perceived Wine Quality

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Wine is a temperature sensitive product that is mostly shipped internationally in non-refrigerated containers. In this research we explored the following questions: What happens to the product along the supply chain from when the product leaves the winery until it is bought by the consumer? To what conditions is the product subjected during its transportation? Do the temperature profiles have any patterns that can help minimize the risk of exposure to extreme temperatures? Finally, do those conditions affect the perceived quality of the product?

For over 5 years we have tracked the temperatures of shipments of wine from vineyards and have recovered more than 1000 temperature data-loggers from 3 different wine-producing regions --- Argentina, Australia and Chile --- to more than 42 different states of the US. Results show that a significant number of the shipments of wine have been exposed to temperatures of at least 30 °C during transportation. We correlated tracking information this data with the temperature to determine where the wine is at greatest risk of exposure to extreme temperatures (from winery to port, at sea, during transshipment and from destination port to the importer). We also measured the regulating effect over temperature of using thermal blankets, by setting devices inside and outside the blanket. Finally, to explore whether typical shipping temperatures will damage wine during transport, we built a heating/cooling device to re-create the temperature trajectories recorded in actual shipments. This enables us to directly compare two bottles of the same wine, one exposed to the re-created shipping temperatures and one not. Five different panels of wine experts blind-tasted such pairs of bottles to see whether they could perceive any differences.

**Keywords:** International supply chain, wine supply chain, wine transport, temperature during transport, thermal liner, effect over perceived quality