

SCIENCE MEETS WINE

A Summary of Dr. Belinda Kemp's 'The Science of Sparkling Wine' RCIScience Talk – September 14, 2017

By: Hamza Taufique and Swapna Mylabathula



During the last week of August, my lab mates and I decided to take an impromptu trip to Niagara-on-the-Lake. The plan: check out the small town and go for a public tour at one of the wineries. On our drive to Niagara-on-the-Lake, a roadside sign on the QEW caught my eye – something along the lines of ‘Wine Research Institute at Brock University’. I had no idea that Brock University harboured a wine research institute. It made sense since the University is in Ontario’s wine country. As a graduate student in the biomedical sciences, I became very curious about ‘wine research’. I love wine but never thought about the science that goes into creating the flavour and aromas that are so unique to each type of wine.

My curiosity about the science of winemaking was answered a few weeks later when Dr. Reinhart Reithmeier (Professor of Biochemistry, University of Toronto and Vice-Chair of RCIS) told me about the upcoming RCIS talk – “The Science of Sparkling Wine” by Dr. Belinda Kemp of the [Cool Climate Oenology and Viticulture Institute \(CCOVI\)](#) at Brock University. Two weeks prior I had seen the roadside sign for a wine research institute on QEW and now there was a public talk by a faculty member from that same institute! As the cliché goes, the world is indeed a small place!

First of all, let’s familiarize ourselves with some wine science language. The science of grape growing is called “viticulture”, and the study of wine science and chemistry is called “oenology”. Cool climate oenology refers to the science of wines that are grown in cooler climates such as that of Southern Ontario. According to [Wine Country Ontario](#), unlike warmer regions where grapes ripen quickly resulting in sweet wines that are low in acidity and high in alcohol content, the grapes in cooler climates ripen slowly and hence accumulate their flavour over a longer period of time. Hence, wines from cooler climates tend to be higher in acidity and have more mineral favours.



I had the great pleasure and privilege of doing a brief interview with [Dr. Belinda Kemp](#) before she gave her talk which was held on September 14, 2017 at the Faculty Club of University of Toronto. Dr. Kemp hails from Brighton, located at the south coast of England. As it turns out, she did not start her academic career as a science student. Trained as a dancer, and having worked at various theatres and circuses, Dr. Kemp always

envisioned herself driving a tractor through vineyards in Barcelona, Spain when she started her undergraduate degree. When that did not pan out due to lack of tractor driving skills, she decided to pursue a career in Viticulture and Oenology research. As she puts it, “I thought I would be doing an awful lot of wine tasting, but soon realized that the undergraduate program involved a lot of biochemistry and science which I ended up liking a lot”. During her undergraduate studies, she did internship stints at wineries around the world. During these internships, she always heard that New Zealand was the place to be for studying viticulture and oenology. After listening to a presentation from Dr Roland Harrison about Lincoln University wine research, she joined Lincoln University’s Centre for Viticulture and Oenology as a graduate student. For her doctoral research, Dr. Kemp studied phenolics in Pinot Noir at Pegasus Bay Winery on the South Island of New Zealand. More specifically, she characterized and quantified tannins and other aroma compounds in grapes after various treatments (such as removal of baseline leaves around the grape cluster) followed by chemical and sensory analysis to determine the chemistry and aroma of the wine. After graduating with a PhD in 2010 from Lincoln University, Dr. Kemp went back to England and taught for almost 3 years at Plumpton College – a partner college of Brighton University.

In July 2013, Dr. Kemp became Senior Scientists in Oenology at Brock University. As she describes it, “I saw a job opening in Canada at Brock, applied for it and then was interviewed over Skype for 3-4 hours while sitting at my kitchen table”. After she accepted the offer from Brock, she moved to Canada and had the very familiar experience of any immigrant – “I didn’t realize how cold it gets in Canada. I was not prepared for it.”



Dr. Kemp’s role at CCOVI is 50% research and teaching, and 50% outreach. Her research focuses mostly on flavour chemistry of sparkling wine and red wine tannins, and it supports the needs of the commercial Ontario wineries. A big part of her outreach role is knowledge transfer back to the commercial wineries, engaging the local community as well as public talks such as the one she was there to give for the RCIS crowd on September 14, 2017. Dr. Kemp talked about ‘The Science of Sparkling Wine’ and went into detail about the bubbles in your bubbly. My colleague, Swapna Mylabathula, provides the highlights of Dr. Kemp’s talk below.

‘The Science of Sparkling Wine’ is a title that will spark interest in many a wine or science enthusiast alike, and Dr. Belinda Kemp and the RCIS did not disappoint in the delivery. Dr. Kemp began by describing the Fizz Club, through which she has established opportunities for winemakers and scientists to exchange research and ideas about all stages of sparkling winemaking. This exchange of knowledge is at the core of the goal of her talk for RCIS, and audience members were thrilled to learn about what makes a sparkling wine and what makes it great – both theoretically and practically, as the event included wine tastings to allow participants to experience what was discussed. Dr. Kemp described the increasing interest across Canada in sparkling wine, with marked growth in sparkling wine production in Ontario, British Columbia, Nova Scotia, and Quebec, as Canada prepares to be the next country to host the International Cool Climate Wine Symposium in 2020. With this increased demand for sparkling wine, winemakers are searching for more information and options for each of the several stages of winemaking.



Sparkling wine differs from other wines in that it contains higher levels of carbon dioxide, which imparts an effervescent quality. This carbon dioxide is produced during the second fermentation, which takes place either in a tank, or each individual bottle of sparkling wine. There are multiple ways to make sparkling wine, and each production method has an effect on the flavour profile of the resulting wine, as well as on the size of its bubbles, foam, and other characteristics. Throughout the talk, the audience became more familiar with the foam and bubbles in sparkling wine. Foam is a key component in sparkling wine, and both its height and stability are factors that are the focus of research. Dr. Kemp also busted wine myths, such as the assumption that smaller bubbles equate to better quality – in fact, it often means that there is higher pressure in the bottle due to a greater amount of carbon dioxide. Dr. Kemp helped the audience differentiate between sparkling and still wines further, through a discussion on macromolecular compounds. Each bubble in a sparkling wine has a film surrounding it consisting of a double layer of proteins and polysaccharides, strengthening the bubble and increasing its stability. In still wines, on the other hand, these proteins are not desirable – they are in fact removed with bentonite, whose positive charge attracts the negatively charged proteins, to avoid the haze that they would otherwise cause in the wine. There is a synergistic relationship between grape and yeast proteins, and while yet unconfirmed, it is thought that the different molecular weights contribute to the ideal combination.

The foam in sparkling wine was also a focus in Dr. Kemp's talk. The audience learned that the foam in sparkling wine differs from beer, in which we also find foam. The foam in sparkling wine is considered 'wet foam', as there is more space between the bubbles. As these bubbles ascend, they get bigger and chains of bubbles can be seen moving up the glass. Dr. Kemp shared a tip for ideal bubbles – bubble formation requires a little dust or something similar to nucleate the bubbles, so it is recommended that sparkling wine glasses are only rinsed

with hot water and never washed with detergent. Bubbles disappear through processes in winemaking such as drainage, as well as through gushing. Gushing, which is the loss of foam upon opening a bottle of wine or beer, can be contributed to by excess pressure, defects in the glass, and other factors, is not desirable. Various compounds in wine can impact the resulting foam. Proteins and polysaccharides are desirable, as already mentioned. The highest concentration of polysaccharides is at about 18 months post-bottling, due to the release of compounds during the autolysis of yeast – so this is when the foam will be most robust. Ethanol levels also impact foam, as when it is too high, bubbles disappear. Acid type also affects foam – tartaric acid



has a positive effect on foam height, while malic acid increases height but not stability, and lactic acid bolsters foam stability. Tannins in excess lead to bitter taste, but condensed tannins also are not desirable because of their negative effect on foam in sparkling wine. Fatty acids and lipids only affect foam when the ethanol in the sparkling wine is below 5%.

For ideal flavour and foam, the timing of the harvest of the grapes is also important. Grapes are picked at the point when the composition of sugar and acid are most desirable. If picked too late in the harvest season, the foam tends to quickly disappear. If the acid drops too quickly, the wine will not be able to age appropriately. Once harvested, grapes destined for sparkling wine are pressed at bunches and not removed from their stems, with gentle pressing. This is because the harder and longer grapes are pressed, the more undesirable compounds are released. So when pressed, the initial fraction is the most ideal for sparkling wine. However, 2nd or 3rd press fractions can still be used in blending or be sold to distilleries. Overall, the science of sparkling wine is multidisciplinary – it includes chemical analysis in a lab, plant biology, soil and water science, microbiology, and sensory science. Many types of science are brought together to produce a beverage that brings people together in social gatherings across the country – including this one, as then, to conclude Dr. Kemp’s talk, it was time to wine down with some sparkling wine tasting of Ontario wines and good company 😊



Hamza Taufique is a molecular neuroscience researcher studying the regulation of metabolism and energy homeostasis. He did his undergraduate degree from UofT Mississauga in Neuroscience and Molecular Biology. He is currently a PhD candidate in the Department of Molecular Genetics at the University of Toronto. Hamza is very active in the graduate student community at UofT and organizes various academic and non-academic workshops for graduate students. He is passionate about science communication and knowledge dissemination.



Swapna Mylabathula is an MD/PhD student at the University of Toronto. Her research interests include injury prevention and management, particularly concussion. Her current research focuses on evaluating concussion policy in Ontario, and examining concussion in female hockey players. Over the past several years, she co-developed a national concussion strategy which received its First Reading in Parliament in Ottawa, co-delivered a TEDx talk on concussions and health advocacy, and presented at national and international conferences. Swapna was honoured to have been recognized as one of the fifty most influential Torontonians by the GridTO for her work. She aims to become a physician scientist with a clinical focus on sports medicine. She is an avid science communicator, and engages in science outreach with schoolkids through various organizations on campus, as well as her involvement with RCIS.