Understanding the Influence of Sensory Attributes on Wine Price: Case study of Pinot Noir Wines

Jingxian An, Wei Yu

Abstract—The commercial value (retail price) of wine is mostly determined by the wine quality, ageing potential, and oak influence. This paper reveals that wine quality, ageing potential, and oak influence are favourably correlated, hence positively influencing the commercial value of Pinot noir wines. Oak influence is the most influential of these three sensory attributes on the price set by wine traders and estimated by experienced customers. In the meanwhile, this study gives winemakers with chemical instructions for raising total phenolics, which can improve wine quality, ageing potential, and oak influence, all of which can increase a wine's economic worth.

Keywords—Retail price, ageing potential, wine quality, oak influence.

I. INTRODUCTION

THE commercial value of a wine is typically defined as retail price of the wine, which serves as an indicator of wine quality as well as a marketing tool [1], [2]. The commercial value of wines can influence consumer purchases while also providing noticeable economic returns to winemakers and wine sellers in terms of marketing. Wine quality, ageing potential, oak influence and wine grade are all important factors in influencing the wine's commercial value.

Wine quality is the most critical factor in determining a wine's commercial value. It is assessed through sensory analysis by trained wine panellists who characterize the products based on their organoleptic characteristics. Although defining wine quality is subjective, there is still some agreement on assessing wine quality. For example, wines with transparent colour, no dominant aromas, no aggressive tastes and balanced overall assessments will be judged as high-quality red wines. Therefore, colour, flavours, mouthfeel, and aroma are essential elements for wine quality that can provide consumers with pleasure and enjoyment [3]. High-quality wines have a high colour intensity, a low hue value, high scores for fresh, dried fruits and spicy aroma attributes, pleasant aromas, moderate astringency, balanced taste, rich and medium body [4]. Phenolic compounds are critical to wine quality because they contribute to oxidative stability and organoleptic characteristics [5].

Experts who taste wines use the idea of "ageing potential" to judge a wine's ability to keep its quality and character [6], [7]. The term ageing potential refers to three things: the amount of time, the quality of the wine, and the level of potential. Wines with low ageing potential may get better and more complex faster, and wines with low ageing potential are only at their best for a short time. In terms of quality, wines with low ageing potential lose their quality as they age, while wines with high ageing potential get better as they age because they get more complex and balanced. High-ageing wines have high tannins, total phenols, anthocyanins, saturated colour, high astringency, moderate acidity, and the right amount of alcohol [8]. High-aging wines did not change much in colour over time, which means that pigments were forming at a slower rate.

Winemakers usually store wines that have been evaluated as having high ageing potential and high quality in oak barrels for mostly 5 to 6 years to work as reserve wines to improve wine quality and increase commercial value. Oak influence can improve wine quality in two aspects. Woods, on the one hand, impart a variety of oak-related compounds into wine, including ellagitannins, furfural compounds, guaiacol, oak or whisky lactone and eugenol. On the other hand, atmospheric oxygen permeation through the oak barrel allows certain compounds to be oxidized gently, resulting in the changes in colour and the modification of wine sensory properties [9]. For example, wine stored in oak barrels can reduce astringency and maintain wine colour stability [10]. Moreover, the influence of oak barrels, namely oak influence, affects wines' complexity and storage aromas [11].

The relationships among wine quality, ageing potential, and oak barrel are illustrated in Fig. 1. The quality of a wine is at the heart of its commercial value. Wines have high commercial values when wines are evaluated as high quality and high ageing potential. Meanwhile, oak influence from oak barrels is a sensory attribute representing wine taster's preferences. Experienced panellists buy wines based on their quality, whereas inexperienced panellists purchase wines based on wine retail price.

Fig. 1 shows that the retail price of a wine seems to be related to wine quality, ability to age, and oak influence. Wine quality, ageing potential, and oak influence all have relationships with phenolic compounds. In this paper, we will find out what the relationship is between wine quality, ageing potential, and oak influence. In the meantime, it will be looked into how phenolic compounds affect wine quality, ageing potential, and oak influence.

II. MATERIALS AND METHODS

A. Pinot Noir Wines

In the study, 78 bottles of commercially available New Zealand wines from five main regions (Central Otago, Marlborough, Martinborough, Nelson and North Canterbury)

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were assessed, with retail prices ranging from NZ $10 to NZ $80, and vintage years from 2011 to 2020.
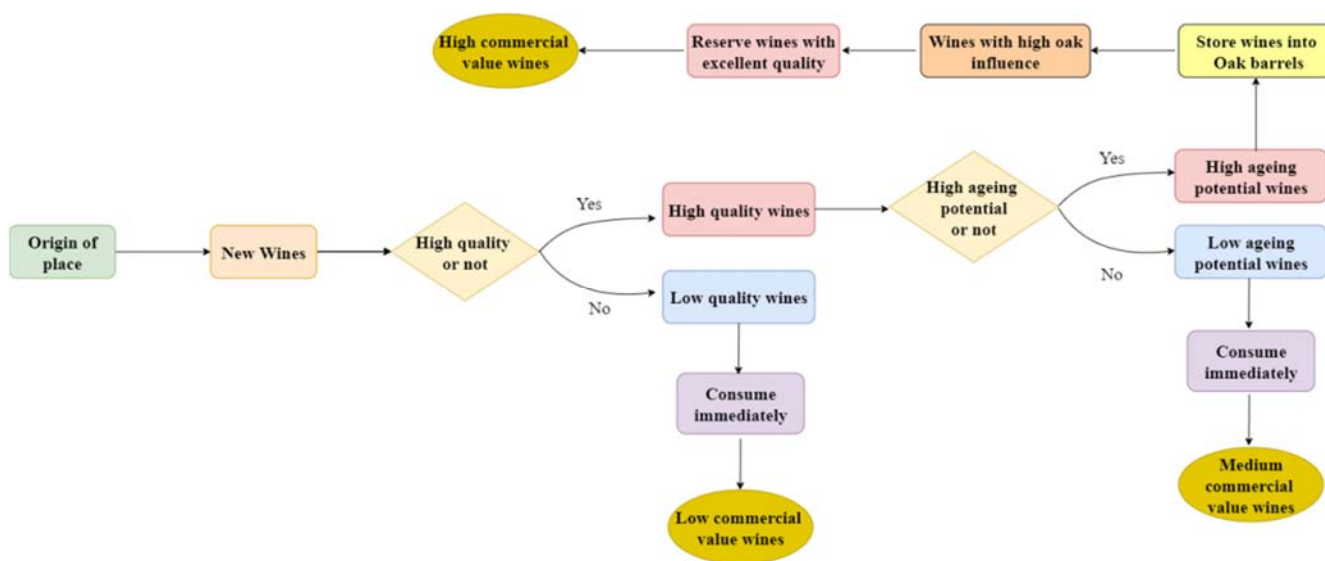

Fig. 1 Schematic view of the interactions of wine quality, ageing potential, and oak influence

B. Analytical Measurements

Shimadzu 2550 glass cells with 0.2 cm path length were used for colour measurements. The colour of red wine can be determined at absorbance 420 nm (A_{420nm}) for yellow colour, absorbance 520 nm (A_{520nm}) for red colour and absorbance 620 nm (A_{620nm}) for blue colour [12]. In addition, the chemical age analysis was performed using the detailed methods as follows. The total phenolics and total flavanol assay was performed using the detailed methods in [13], [14]. Furthermore, total flavan-3-ols, total anthocyanins and total tannins assays were performed using the methods outlined in [15] and [16].

C. Sensory Evaluation

A panel of seven trained panellists (six men and one woman, ages 24 to 40) assessed the 36 sensory attributes of 78 bottles (labelled from No.1 to No.78). These panellists included commercial winemakers, wine sellers, and wine science scholars. Members of the panel had wine evaluation experience ranging from 2 years to 15 years. Wine samples (30 mL) were poured into ISO standard tasting glasses labelled with a two-digit code. Each panellist had their tasting. Soda water was provided to cleanse the palate, and coffee beans were provided to refresh the nose. The sensory attributes were rated by panellists on a scale of 1 to 10. Score 1 indicates that the sensory attribute is unacceptable or has a low intensity, while score 10 indicates that the sensory attribute is prominent or has a high intensity.

III. RESULTS AND DISCUSSION

A. Relationship between Ageing Potential, Oak Influence, Wine Quality and Chemical Information

The relationship between wine quality, oak influence, ageing potential, and chemical information can provide instructions on how to improve these sensory attributes, which can bring commercial value to winemakers.
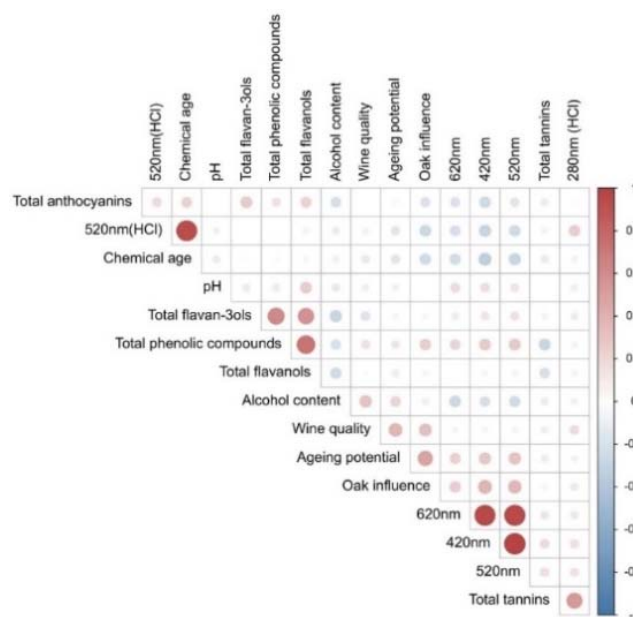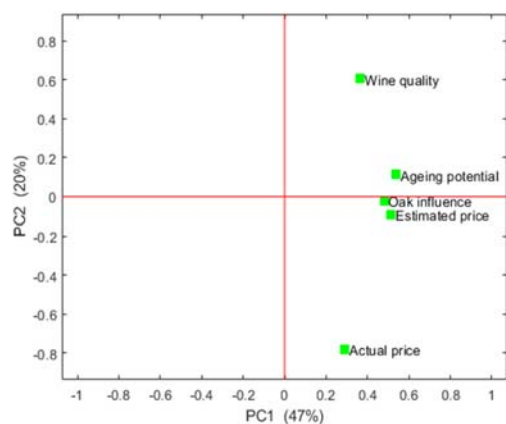

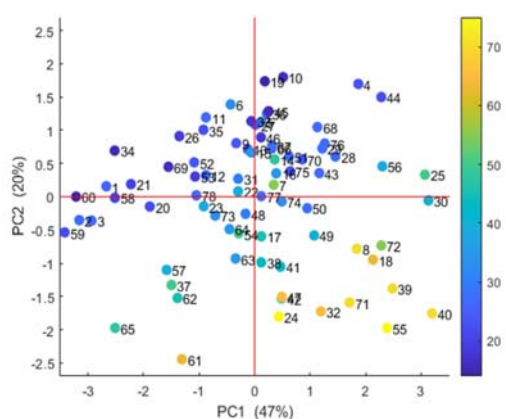Fig. 2 The relationship among wine quality, oak influence, ageing potential and chemical data

The relationship among 78 bottles' (*No.1~No.78*) wine quality, oak influence, ageing potential and chemical data are investigated by Pearson correlation in Fig. 2. The figure shows that wine quality, ageing potential and oak influence have positive relationships. Total phenolic compounds can positively impact oak influence, wine quality and ageing potential. It gives indications to winemakers that if they want to improve wine quality and ageing potential, they need to focus on increasing

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total phenolics in wines. Meanwhile, A_{420nm}, A_{520nm} and A_{620nm} have positive associations with ageing potential and oak influence according to Fig. 2.

B. Relationship between Wine Commercial Value, Wine Quality, Evaluated Price, Ageing Potential and Oak Influence

(a) PCA loading plot

(b) PCA score plot

Fig. 3 The relationship among wine quality, oak influence, ageing potential, actual price and evaluated price

PCA is a popular multivariate statistical analysis to reduce data dimensionality while preserving patterns. PCA is used in this paper to check the relationship between wine quality, ageing potential, oak influence and wine quality.

According to literature review, researchers always state that ageing potential, wine quality and oak influence can positively influence wines' commercial value (retail price) [6], [9]. PCA will determine whether this statement is true or not. Also, which sensory attribute has the greatest influence on panellists' estimation of wine price will be examined.

During sensory evaluation, seven trained panellists estimate the retail price of individual Pinot noir wines to determine which sensory attributes have the greatest influence on them. Seven trained panellists have evaluated 78 bottles of Pinot noir wines' price and the average scores from seven panellists' estimated price are regarded as evaluated price in PCA analysis. The relationship among actual price, evaluated price, oak

influence, ageing potential and wine quality by PCA analysis in Fig. 3. Fig. 3 (a) shows that trained panellists can successfully estimate the actual price of Pinot noir wines to a certain extent. Oak influence, wine quality, and ageing potential are all positive sensory attributes for Pinot noir wines. Among wine quality, oak influence and ageing potential, oak influence is the most important sensory attribute influencing wine traders to set prices and trained panellists to estimate prices.

IV. CONCLUSION

This paper certifies that wine quality, ageing potential and oak influence all have a positive influence on wine pricing. Among these three sensory attributes, oak influence has the greatest influence on price setting by wine traders and price estimation by experienced consumers. This paper also provides winemakers with chemical instructions for improving wine grades; by increasing total phenolics can improve wine quality, age potential and oak influence, all of which can boost the commercial value of a wine.

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