Effects of Different Inoculation Regimes of *Torulaspora delbrueckii* and *Oenococcus oeni* on Fermentation Kinetics and Chemical Constituents of Durian Wine

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This work evaluated the effects of inoculation time of *Oenococcus oeni* on the kinetics of fermentation and chemical constituents of durian wine produced using a non-*Saccharomyces* yeast, *Torulaspora delbrueckii*. The growth of *T. delbrueckii* in mixed-culture fermentations was significantly adversely affected by the presence of *O. oeni*, and the growth of malolactic bacteria was also affected by the metabolism of yeast during fermentation. The level of ethanol produced in simultaneous alcoholic and malolactic fermentation (SIM, 6.93%, v/v) was comparable to that in the *Saccharomyces cerevisiae* EC-1118 control (6.75%, v/v); both levels were relatively higher than that in the *T. delbrueckii* Biodiva control (6.39%, v/v) and the other two sequential fermentations (oenococci inoculated after four and seven days of alcoholic fermentation, SEQ 4th, 6.34% and SEQ 7th, 6.33% v/v respectively). The final concentrations of organic acids and esters in the mixed-culture wines were correlated with the inoculation time of *O. oeni*. SIM produced relatively higher levels of ethyl esters (ethyl esters of hexanoate, octanoate, decanoate and lactate) and acetate esters (ethyl acetate and isoamyl acetate) than those in SEQ 4th, SEQ 7th and the Biodiva control. This suggests that SIM would contribute fruity aroma properties to and modulate the mouthfeel of durian wine. The production of 3-(ethylthio)-1-propanol could compensate for the weak onion-like odour caused by the decrease in initial volatile sulphur compounds. Overall, this research suggests that SIM treatment is an effective way to produce durian wine with higher ester production.

INTRODUCTION

In recent years, an increasing number of researchers have been paying more attentions to wines from tropical fruit such as banana (Byarugaba-Bazirake *et al*., 2013), papaya (Lee *et al*., 2010) and lychee (Chen & Liu, 2016) due to their pleasant and characteristic flavours. Other tropical fruits, such as durian and mangosteen, are also promising for novel fruit wine production but have received much less research attention than other fruits. Durian (*Durio zibethinus* Murr.) is a unique and popular tropical fruit grown widely in Southeast Asia. Durian is not only a good source of carbohydrate, fat, fibre and protein, but also contains abundant phenolic compounds, and medium-chain saturated and unsaturated fatty acids (Haruenkit *et al*., 2010). In addition, there are more than 170 volatile aroma compounds found in the durian flavour compound array, including esters (e.g. ethyl 2-methylbutyrate) and volatile sulphur compounds (e.g. thiols and sulphides) (Ho & Bhat, 2015). Durian is normally consumed fresh and its availability is limited to its fruiting season from May to August, and short shelf life of two to five days at room temperature (Haruenkit *et al*., 2010). Therefore, alcoholic fermentation (AF) of durian pulp may provide an alternative way to preserve, extend shelf life and add value to this fruit.

Alcoholic fermentation is normally conducted by *Saccharomyces cerevisiae* strains with the conversion of sugars to ethanol, and yeasts play a significant role in the production and modulation of the wine aroma profile by releasing flavour compounds from fruit precursors or synthesising yeast-derived aroma compounds (Viana *et al*., 2008; Sun *et al*., 2013; Tristezza *et al.*, 2013, 2016). Recently, non-*Saccharomyces* yeasts like *Torulaspora delbrueckii* received more attention due to their potential positive roles in the organoleptic characteristics of wines, such as the production of low levels of volatile acidity and acetaldehyde,

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