Yeasts for brewing of non-alcoholic gruit: Sensory profile and flavor forming properties

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Introduction

Background: Gruit does not contain hop and thus hop bitterness and aroma. Production of such beverage is demanding in terms of sensory quality. Desirable sensory-attractive compounds, such as esters and higher alcohols, can be provided by yeasts. Higher alcohols may affect drinkability of such beverages. For example, products with high concentration of amyl alcohol is perceived as heavier. Esters in moderate concentrations can impart a satisfying, full-bodied character to the drink aroma.

Aim: The study aimed to examine sensory profiles and flavor forming properties in prototype gruits produced by five yeasts strains.

Materials and methods

Yeasts and fermentation: Light Munich Malt (type 1) was used for mashing. *Saccharomyces cerevisiae* (SafBrew™ LA-01, Fermentis, France), *Saccharomyces cerevisiae* (SafAle™ S-33, Fermentis, France), *Saccharomycodes ludwigii* DBVPG 3010 (Industrial Yeast Collection, University of Perugia, Italy), *Saccharomycodes ludwigii* WSL-17 (Hefebank Weihenstephan, Germany) and *Torulaspora delbrueckii* WLP 603 (White Labs, USA) were used for fermentation in four different temperatures (5, 10, 15 and 20 °C) on worts of low fermentable sugars (<40% of total sugars) and gravity level (8°Blg). The fermentation was stopped after 7 days, or when ethanol content reached 0.5% vol.

Analyses: To find compounds of sensory importance, volatile profile were analysed after fermentation using an Agilent HeadSpace (7697A), a GC (7820A) and a MS (5977B) (Agilent, USA). A panel of 10 previously trained experts carried out the Quantitative Descriptive Analysis (QDA®) to describe the sensory profile of prototype gruits. The intensity of each attribute was determined on a non-structural graphical scale showing the anchoring points (described as "undetectable" and "very intensive"). Results were converted into numerical values in a range of 0 to 100 units and subjected to a one-way analysis of variance followed by the Fisher LSD test at the significance level α=0.05. Overall sensory quality assessments were normalised using min-max technique on a scale 0-100%.

Results

Temperature of 20°C resulted in a rapid wort fermentation by *S. cerevisiae* LA-01 and *S. cerevisiae* S-33. Samples fermented in 10° C and 15 °C received average better ratings of their overall sensory quality. Significant differences in sensory attributes were observed between samples depending on the fermentation temperature (Fig. 1-5; significant differences marked by★).

Table 1. Volatile compounds identified and their sensory notes in the tested gruits

COMPOUND IDENTIFIED	COMPOUND SENSORY NOTE
Higher alcohols	
3-Methyl-1-butanol (isoamyl alcohol)	Alcohol, banana, sweetish, aromatic
Isopropyl alcohol (2-propanol)	Alcoholic, woody, musty
Propan-1-ol (n-propanol)	Alcohol, fermented, weak fusel, musty, yeasty, sweet, fruity
Isobutanol (2-Methylpropyl alcohol)	Alcohol, solvent
2-Methyl-1-butanol (active amyl alcohol)	Alcohol, banana, medicinal, solvent
Furfuralcohol	Bready, burmt musty
n-Hexanol	Herbaceus, greasy
2-Phenyl ethanol	Roses, seetish, perfumed
Aldehydes	
Furfural	Bready, nutty caramel burnt, almond, woody, sweet
Acetaldehyde	Green leaves, fruity
2-Methylpropanal (isobutyraldehyde)	Grainy, like germinating malt
Benzene acetaldehyde	Honey-like, sweet, rose, green, grassy
5-Hydroxymethyl-furfural	Fatty, buttery, musty, waxy, caramellic, herbal, hay
3-Methyl-butanal (valeric aldehyde)	Malty, nutty, ethereal, aldehydic, peach, fatty
2-Methyl-butanal (Isovaleraldehyde)	Malty, nutty, ethereal, aldehydic, peach, fatty
Esters	
Ethyl acetate	Solvent, fruity, sweetish
Isoamyl acetate	Banana, apple, solvent, estery
Vicinal diketones	
2,3-Pentanedione	Honey-like, buttery, rancid, sweet
2,3-Butanedione (diacetyl)	Butter-scotch
Vinyls	
Styrene	Plastics, like polystyrene
Acids	
Acetic acid	Sour, vinegar, sharp pungent

For *S. cerevisiae* S-33 and S. *ludwigii* WSL-17 yeasts, fermentation in 5°C resulted in a more intense worty taste than fermentation in 15 °C (Fig. 2 and 4). Intensity of sweet and grain tastes were higher in gruits produced by *S. ludwigii* (3010 and WSL-17) in 5 °C than in beverages fermented in higher temperatures (Fig. 3 and 4). Gruits fermented in temperatures 10-20 °C using *T. delbrueckii* yeast were found as less hazy, less malty in odour and less sour in taste. Sensory quality was reflected in the profile of volatile compounds. Samples with pronounced malty, grainy and worty sensory attributes were characterised by high content of aldehydes: furfural and 3-Methyl-butanal. Higher alcohols were the largest group of compounds in the volatile fraction. High content of these compounds was related to a better sensory quality of tested samples. Samples with moderate amount of propan-1-ol and isobutanol were preferred. Mean overall sensory quality of the tested gruits ranged between 2.67 and 3.38, on a scale between 1 (bad) and 5 (excellent).

Conclusion

Fermentation at 10 °C and 15 °C for tested yeasts gives gruits with more desirable sensory characteristics, which is related to a low content of aldehydes and a high content of higher alcohols. In these temperature levels, gruits obtained more positive sensory assessments.

Acknowledgement

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Fig. 1. Influence of fermentation temperature on volatile and sensory profile of gruit produced by the *S.cerevisiae* LA-01 yeast

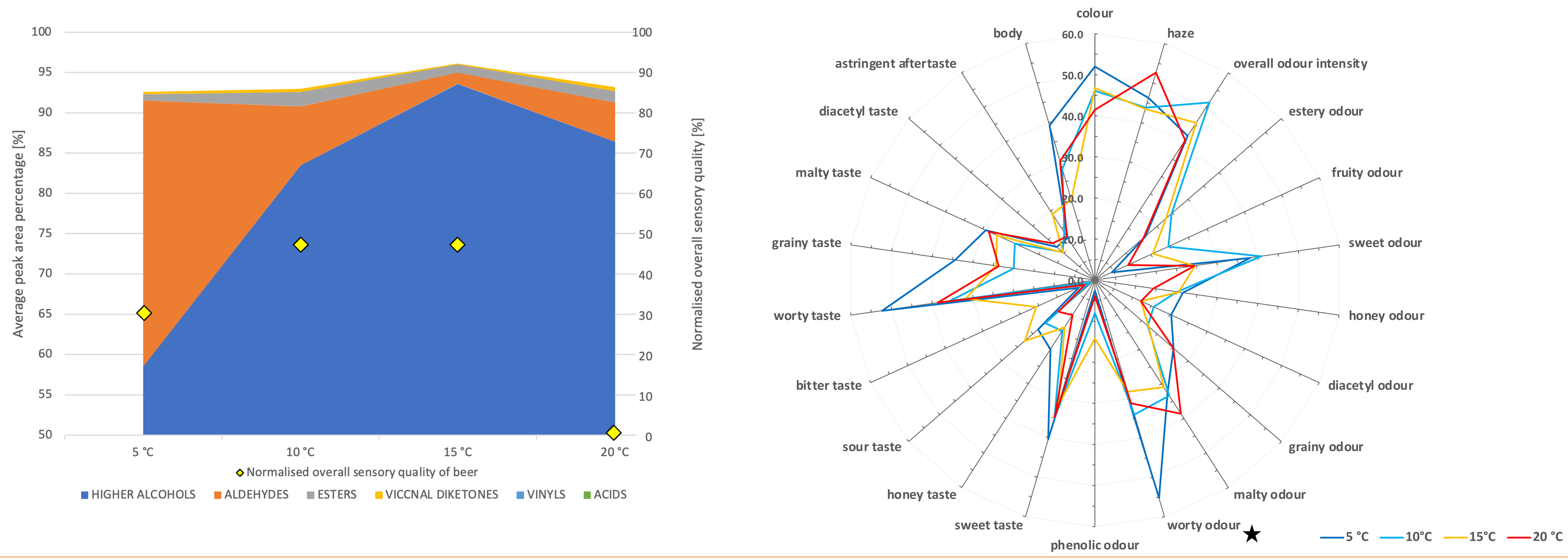

Fig. 2. Influence of fermentation temperature on volatile and sensory profile of gruit produced by the *S.cerevisiae* S-33 yeast

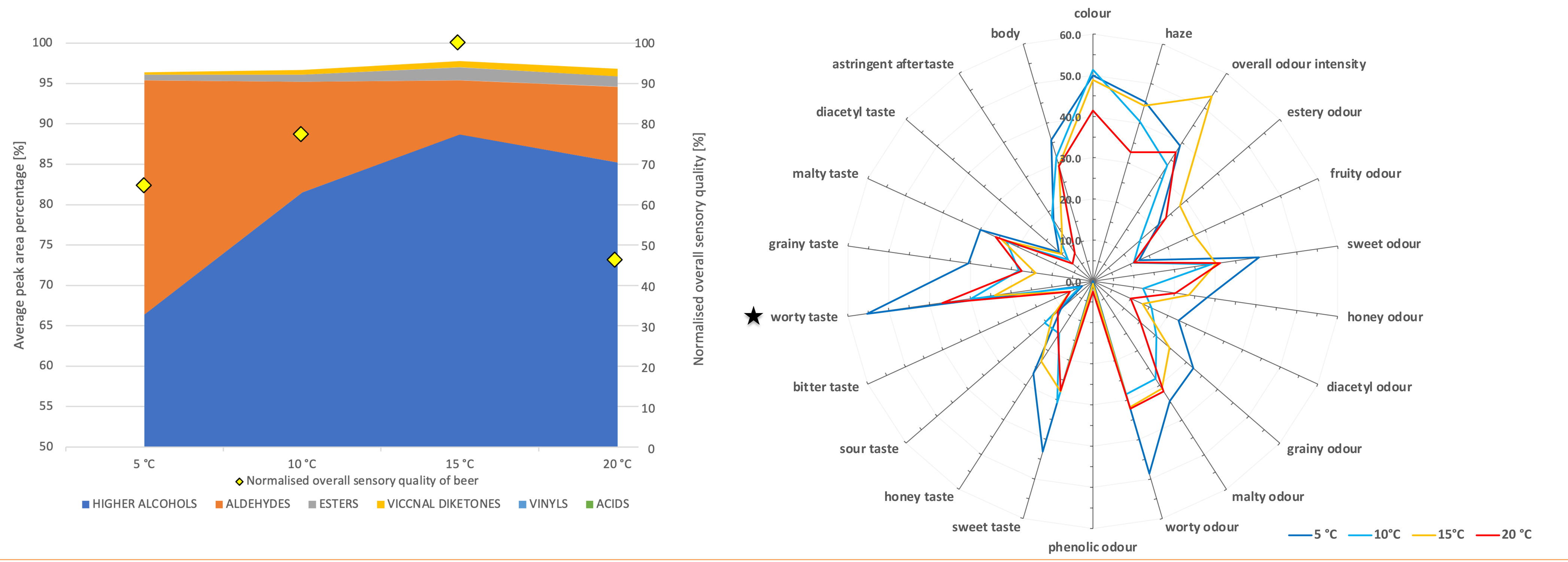

Fig. 3. Influence of fermentation temperature on volatile and sensory profile of gruit produced by the *S. ludwigii* 3010 yeast

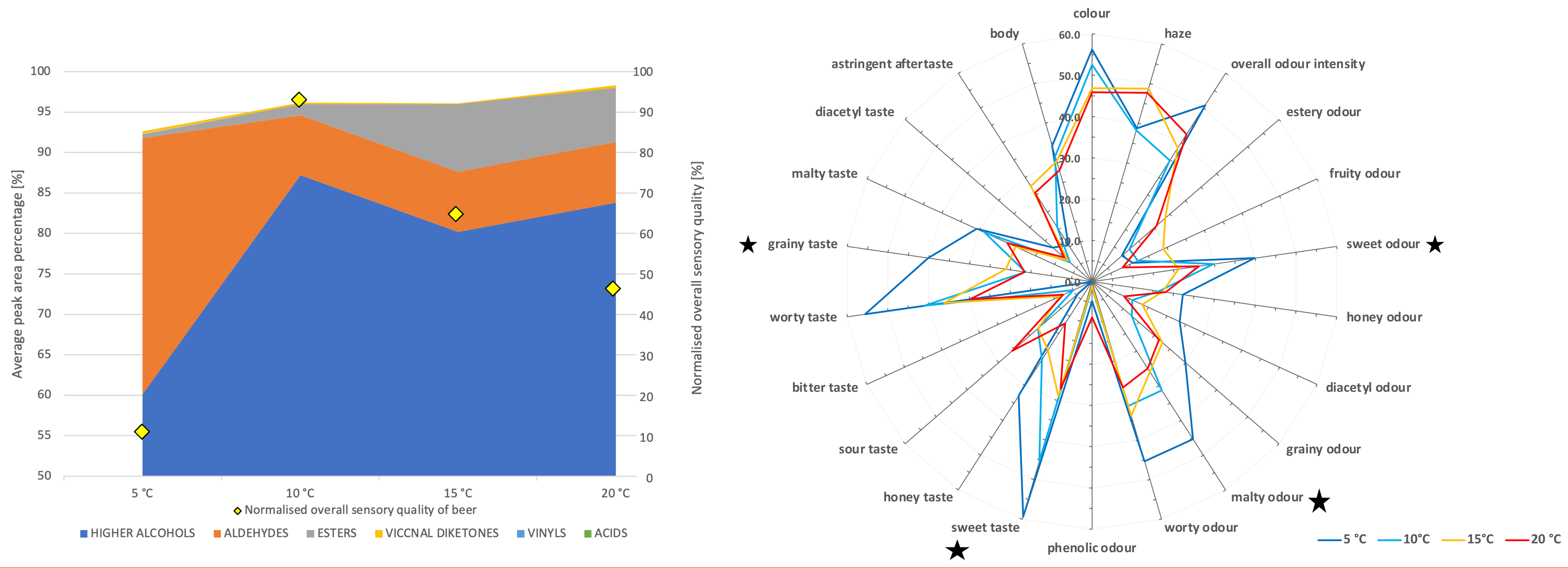

Fig. 4. Influence of fermentation temperature on volatile and sensory profile of gruit produced by the *S. ludwigii* WSL-17 yeast

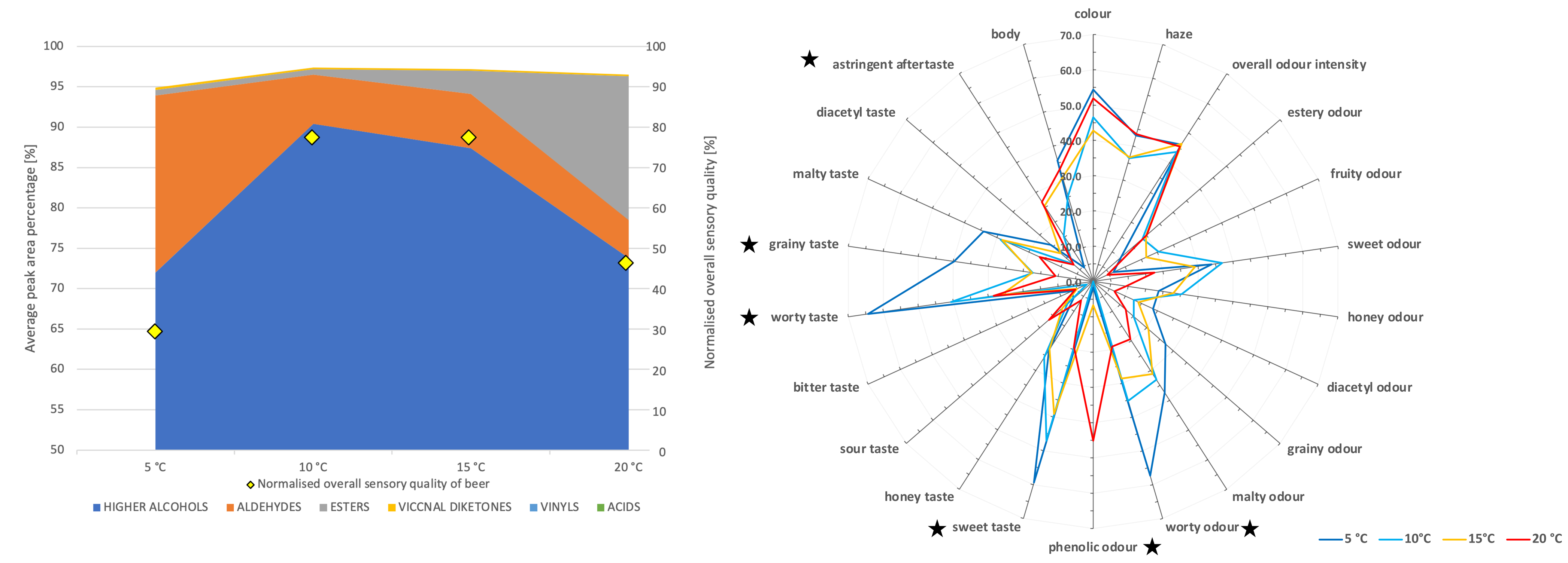

Fig. 5. Influence of fermentation temperature on volatile and sensory profile of gruit produced by the *T. delbrueckii* WLP 603 yeast