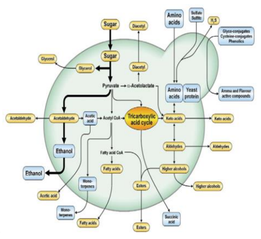
The impact of nutrients on yeast fermentation and Pálinka quality

Fatjona Fejzullahu, Viktória Németh, Tamás Frey, Szilárd Kun

Hungarian University of Agriculture and Life Sciences, Institute of Food Science and Technology, Department of Bioengineering and Alcoholic Drink Technology, Budapest, Hungary

INTRODUCTION

The production of high quality Pálinka relies on the successful completion of alcoholic fermentation and the production of desirable flavour compounds by yeast strains. Flavour compounds encompass all volatile and non-volatile compounds that contribute to the perception of aroma, taste and mouthfeel (Francis & Newton, 2005). Although flavour production and fermentation performance of yeasts are genetically determined, these characteristics are also greatly dependent on fruit mash composition (including nutritional factors) and environmental conditions (Rollero et al., 2014). It should be noted that it is not solely sugars that impact on yeast fermentation performance. Yeasts also require appropriate supplies of other major, minor and trace nutrients, together with water, in order to efficiently carry out fermentation (Walker & Stewart, 2016). When nutrients are present in insufficient amounts or in excess, major fermentation problems such as sluggish fermentation, fermentation arrest, or the production of metabolites perceived as off-flavour compounds can arise (Bisson, 1999). Thus, the fermentation-derived flavour outcomes can be manipulated by the use of suitable yeast strains and also by the addition of nutrients aimed to improve the fermentation kinetics and the overall quality of the spirit.



AIM OF RESEARCH

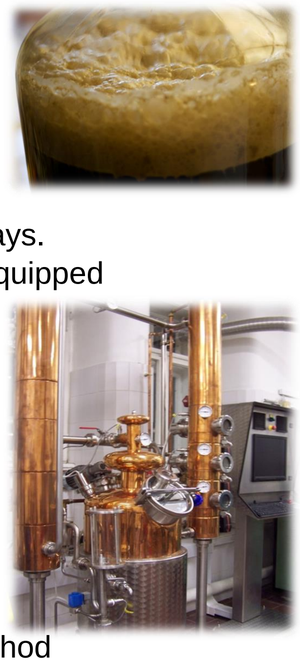
- To assess the impact of five different nutrient supplementations (added either to the initial fruit mash or at different stages of fermentation), on the fermentation performance of *Saccharomyces cerevisiae*.
- To determine their effect on the quality and sensory characteristics of Pálinka.
- To determine their potential and opportunity for future use.

MATERIAL AND METHODS

Applied raw material: Jonagold apple
Applied starter cultures: *S. cerevisiae* (Uvaferm 228, Lallemand)

Parameters of Mashing and Fermentation Process:

- ✓ Pectin degradation using Lallzyme™ HC enzyme
- ✓ Phosphoric and lactic acid (95:5)
- ✓ Nutrients:
  1. VitaFerm® Ultra F3 (Erbslöh),
  2. Vitamon® A (Erbslöh),
  3. VitaDrive® F3 (Erbslöh),
  4. Optimum White® & Uvavital (Lallemand)
  5. V Starter Premium & FosfoAktiv Premium & Booster Premium (Enologica Vason).
- ✓ The fermentation was carried out at 16±1°C for 10 days.
- ✓ Distillation: Computer-controlled steam-heated still equipped with a rectifying column



Applied analytical methods:

- ✓ Dry matter content - Digital refractometer
- ✓ Titratable acidity – Potentiometric titration
- ✓ Fusel oil content
- ✓ Ester content - Titrimetric method
- ✓ Ethanol content - Automatic density meter
- ✓ Sugar and organic acid concentrations – HPLC
- ✓ Reducing sugars content - Schoorl-Regenbogen method
- ✓ Sensory evaluation - 20-point system test

REFERENCES

1. Bisson, L. (1999). Stuck and sluggish fermentations. American Journal of Enology and Viticulture 50(1): 107–119.
2. Francis, I. L., & Newton, J. L. (2005). Determining wine aroma from compositional data. Australian Journal of Grape and Wine Research 11(2): 114–126.
3. Rollero, S., Bloem, A., Camarasa, C., Sanchez, I., Ortiz-Julien, A., Sablayrolles, J. M., Dequin, S. & Mouret, J.R. (2014). Combined effects of nutrients and temperature on the production of fermentative aromas by *Saccharomyces cerevisiae* during wine fermentation. Applied Microbiology & Biotechnology 99: 2291–2304
4. Walker, G. M. & Stewart, G. G. (2016). Saccharomyces cerevisiae in the production of fermented beverages. Beverages 2(30): 1-12.

RESULTS AND DISCUSSION

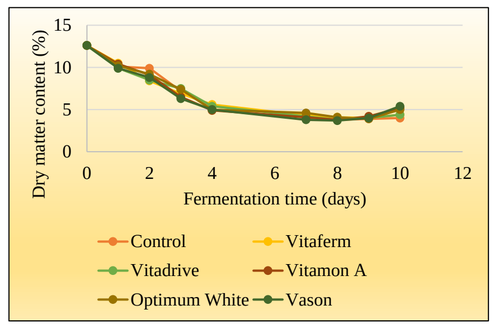


Figure 1. The profile of refraction during fermentation process

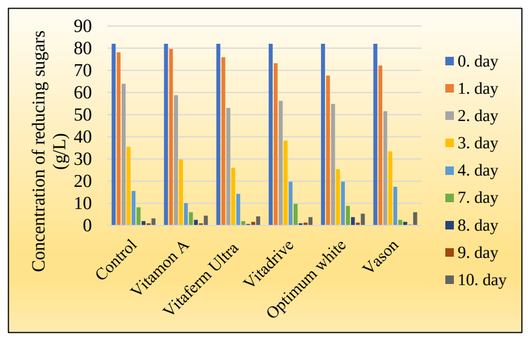


Figure 2. Changes of the concentration of reducing sugars during fermentation process

- ➢ S. cerevisiae showed similar characteristics during mash fermentation, regardless of the nutrient addition. In each case the yeast gradually utilized the available carbohydrate source, thus fermentation went quickly and smoothly (Figure 1 & 2).
- ➢ The level of titratable acidity increased during fermentation, probably as a result of the production of some organic acids as normal products of yeasts metabolism (Figure 3).

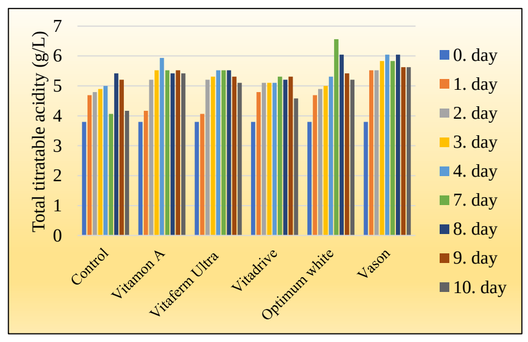


Figure 3. Changes of the acidity during fermentation with different starter cultures

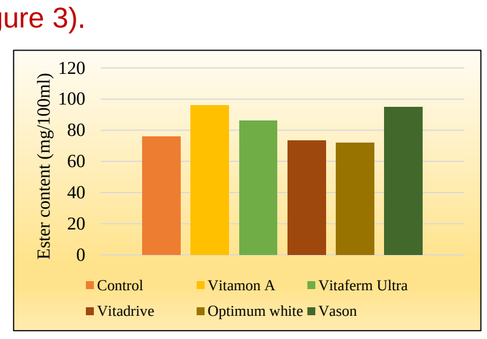


Figure 4. Ester contents of the distillates

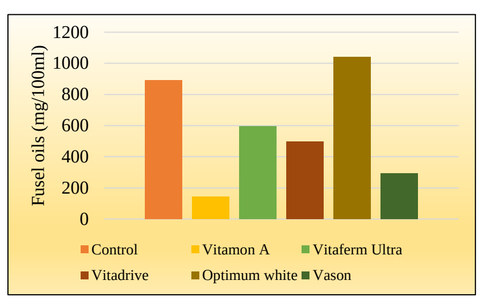


Figure 5. Fusel oil contents of the distillates

- ➢ Esters and fusel oils contribute to the aroma of the distillates. In the heart fraction produced from the mash supplemented with Vason and Vitamon A nutrients, a greater ester content was detected. Whereas the highest fusel oil content was obverved in the samples named Optimum white and Control (Figure 4 & 5).

- ➢ The acidity contributes significantly to the sensory perception and quality of Pálinka. Some organic acids originate from the fruit, others form during alcoholic fermentation. The most acetic and lactic acid was produced by the sample supplemented with Vitadrive, whereas the highest amount of succinic acid was detected in Vitamon A (Figure 6).
- ➢ HPLC measurements revealed no major differences in sugar concentrations between samples throughout the fermentation process. In the samples supplemented with Vitamon A and Vason nutrients, the yeast was able to utilize glucose, fructose and sucrose significantly better (Figure 7).

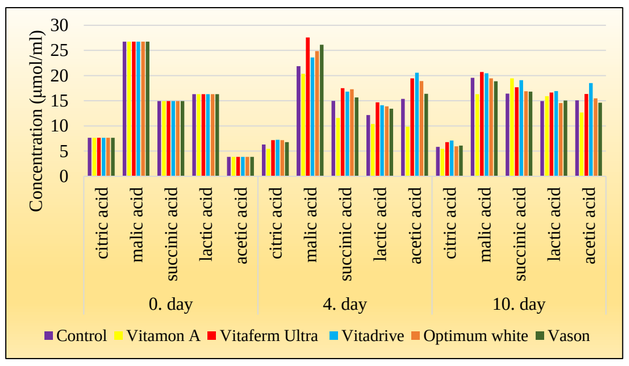


Figure 6. Changes of the organic acids concentrations during fermentation

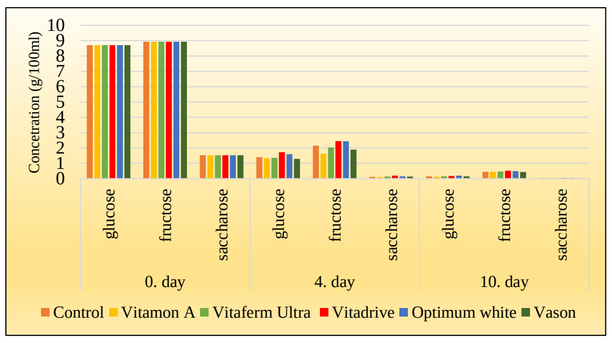


Figure 7. Changes of glucose, fructose, saccharose concentrations during fermentation

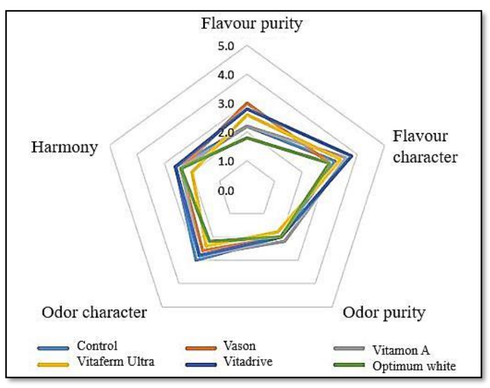


Figure 8. Results of organoleptic evaluation

- ➢ According to the sensory evaluation, the best Pálinka was produced by the mash supplemented with Vitadrive nutrients (Figure 8).

CONCLUSION

In conclusion, the addition of nutrients didn't significantly affect the fermentation kinetics of *S. cerevisiae* but gave rise to the production of some chemical compounds which contribute to the flavour of the distillate. Ultimately, this assessment will contribute to practical guidelines for Pálinka production, aiming to improve aroma profile, style, and quality.