The future of DMS precursors during alcoholic fermentation: impact of Yeast Assimilable Nitrogen levels on the content of DMSp in young wines.

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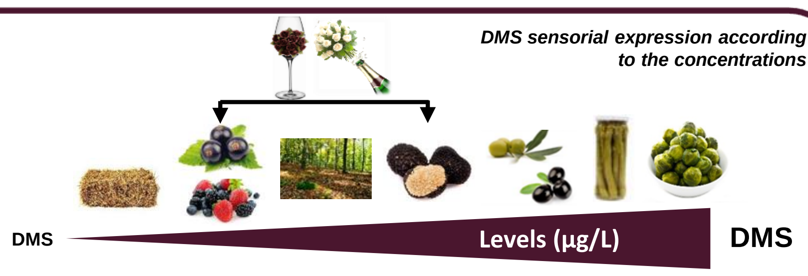
INTRODUCTION

During bottle ageing, some wines can develop an aromatic « bouquet ».This sensory phenomenon is desired by winemakers and is a sign of quality for patient wine connoisseurs[1]. Dimethyl sulfide (DMS) is implicated in the typical expression of red wine ageing bouquet[2,3]. Due to its multi-faceted sensory aspects and depending on its concentration, DMS participates in the expression of wine complexity. DMS is a result of the hydrolysis of its precursors called DMSp (mostly made up of *S*-methylmethionine: SMM), present in the grape[4]. Previous studies observed an indirect link between DMSp and YAN in grapes[5] and authors reported that DMSp levels in grapes are 20 to 30 times higher than those observed in young wines[6].



Can we modulate the DMSp decrease by modulating YAN?

Different scales of experiments

Cellar scale

OBSERVATIONS

❖ Materials and methods

Wine-growing domain experiment

- Merlot must
- Preparation of selected yeasts
- YAN adjustment by the estate
- Winemaking in 250 hL tanks

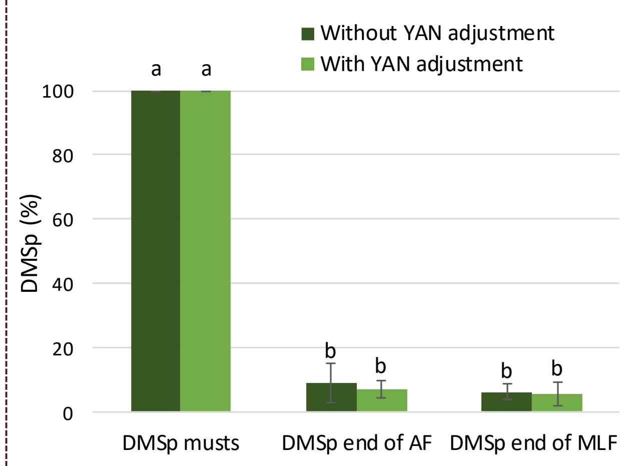
Transfer unit in laboratory

- Merlot must
- Commercial yeasts F33 (Laffort®)
- Initial YAN in must: ø adjustment
- Winemaking in 10 L tanks

→ Monitoring of DMSp during winemaking

→ Analysis of DMSp by GC-MS[7]

❖ Results and discussion



Main observations:

- DMSp levels decrease during AF stage (loss of 90%)
- Low diminution during malolactic fermentation (MLF) stage
- DMSp levels lower in non-adjusted musts compared to adjusted musts

→ Need to work at the laboratory scale on AF stage to understand this phenomenon

Laboratory scale

Is it an effect of CO_2 bubbling during AF?

❖ Materials and methods

1) *Model must matrix*: 200 g/L sugars (glucose + fructose); 4 g/L tartaric acid; pH: 3.3 + addition SMM to have DMSp at 3000 µg/L

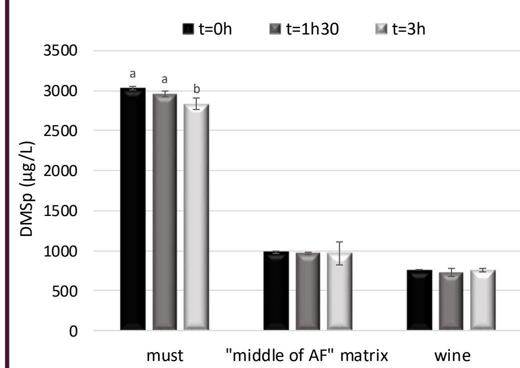
2) *Model « middle of AF » matrix*: 100 g/L sugars (Glucose + Fructose); 6% ethanol (v/v); 4 g/L tartaric acid; pH: 3.4 + Addition SMM to have DMSp at 1000 µg/L

3) *Model wine matrix*: 12% ethanol (v/v); 4 g/L tartaric acid; pH: 3.5 + addition SMM to have DMSp at 700 µg/L

→ To check the influence of AF bubbling on DMSp loss:
Bubbling with N_2 for 0; 1h30; 3h

→ Analysis of DMSp after hydrolysis by GC-MS

❖ Results and discussion



The effect of bubbling was tested to ensure that the DMSp descrease during AF wasn't caused by the imbalance of DMS/SMM due to CO_2 release.
On the 3-model matrix tested, DMSp levels weren't affected by bubbling.
So, there doesn't appear to be a release/training mechanism without microorganic activity.

Now, the objective is to understand when and how DMSp decreases during AF, depending on YAN levels in the matrix.

What is the effect of YAN levels in DMSp decrease?

❖ Materials and methods

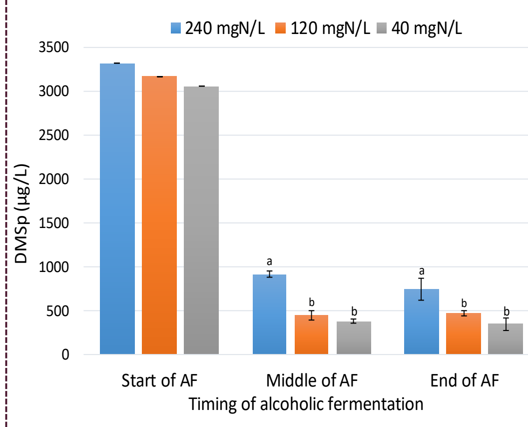
- Synthetic must (SM) [220 g/L of sugars] using protocol developed by Bely[8] and Marullo[9]
- Addition of 10 mg/L of SMM to have DMSp at 3000 µg/L

Variation of YAN → Modality 1: 240 mgN/L x3 | Modality 2: 120 mgN/L x3 | Modality 3 40 mgN/L x3

Inoculated at 10^6 ¢/mL with *S. cerevisiae* FX10 (Laffort®)

Fermentations monitored by evaluating CO_2 evolution
Sampling and quantification of pDMS by GC-MS at start, middle and end of AF

❖ Results and discussion



This 2nd experiment was to observe the effect of YAN levels on microbial activity during AF in a simplified matrix, particularly in decreasing DMSp.
Results showed that DMSp decreases between the start and the middle of AF. Then, the levels of DMSp remain stable until the end of AF. As above, the decrease of DMSp occurs at all YAN levels, although the deficient YAN modalities (2 and 3) induce significantly more marked decreases.

Then, we checked if the composition of YAN can influence the final levels of DMSp

Laboratory scale

Is there an effect of YAN composition in the preservation of DMSp during AF?

❖ Materials and methods

- Synthetic must (SM) [220 g/L of sugars] using the same protocol
- Addition of 10 mg/L of SMM to have DMSp at 3000 µg/L

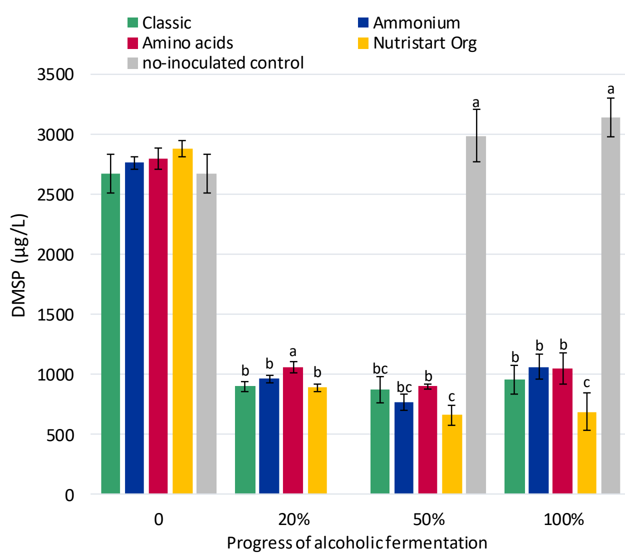
Synthetic must at 110 mgN/L + 90 mgN/L of differents adjustments

- ***Modality 1: Classic*** (1/3 NH_4^+ and 2/3 amino acids)
- ***Modality 2: Ammonium*** (100% NH_4^+)
- ***Modality 3: AA*** (100% AA)
- ***Modality 4: Nutristart Org®*** (100% yeast autolysate preparation)

Inoculated at 10^6 ¢/mL with *S. cerevisiae* FX10 (Laffort®) — x3 x3 x3 x3

Fermentations monitored by evaluating CO_2 evolution
Sampling and quantification of pDMS by GC-MS at 0, 20%, 50% and 100% of alcoholic fermentation progress

❖ Results and discussion



DMSp decrease occurs within the first 20% of AF evolution when yeasts are in their growth phase (36 to 48 h after inoculation).
Then, the dynamic of DMSp levels is stable.
On the contrary, DMSp levels of the non-inoculated control, measured only at 0, 50% and 100% of AF evolution, were stable.
This confirms microbial action in decreasing DMSp.

The nature of the nitrogen in the synthetic must doesn't influence the preservation of DMSp.

TAKE HOME MESSAGE

During AF, DMSp levels decreased with a loss of more than 90%. So, AF is a crucial step in the future of DMSp precursors.
We had to understand what were the key parameters that could affect the loss and if we are able to modulate the DMSp content by modulating YAN content.
First results gave the following information.

- **No effect of CO_2 bubbling during AF on the decrease of DMSp – No release mechanism without microbial action.**
- **Loss of DMSp occurs at all YAN levels but is significantly more important at deficient nitrogen levels.**
- **No effect of YAN composition on the preservation of DMSp levels during AF.**

Future experiments should be carried out to understand the mechanisms of DMSp consumption to assure the ageing potential of the wines in the current context of changing winemaking practices and climate.

ISVV Institut des Sciences de la Vigne et du Vin Bordeaux Aquitaine · Université de Bordeaux · Bordeaux INP Aquitaine · INRA Science & Impact

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