Coinoculation and red wine long maceration
Questions/Answers with my winemaking experience
Conference presented during Lallemand Technical Meeting
Lisbon, Portugal, April 2013
If we manage the following microbial situation, no special problem with long maceration and malolactic fermentation with coinoculation yeast-bacteria
Microbial populations evolution (semi-log scale) with alcoholic and malolactic fermentation Good Practices (GP)

- **SO₂ addition as soon as malic is finished**
- **Yeast inoculation**
- **1 week**
- **LAB living population**
- **LAB (Lactic Acid Bacteria) coinoculation**
- **Indigenous Lactic Acid Bacteria living population**
- **Indigenous Brettanomyces sp. living population**

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Microbial populations evolution (semi-log scale) with alcoholic and malolactic fermentation Good Practices (GP)

SO₂ addition as soon as malic is finished

Selected yeast active population applies a very intense ecological pressure on indigenous LAB and Brett

Selected LAB active population applies an ecological pressure on indigenous LAB and Brett

Indigenous Brettanomyces living population

LAB living population (Lactic Acid Bacteria) coinoculation

Indigenous Lactic Acid Bacteria living population

Selected LAB active population applies a very intense ecological pressure on indigenous LAB and Brett

Yeast living population

LAB (Lactic Acid Bacteria) coinoculation

SO₂ addition as soon as malic is finished
Microbial populations evolution (semi-log scale) with alcoholic and malolactic fermentation Good Practices (GP)

Yeast inoculation

Yeast living population

LAB (Lactic Acid Bacteria) coinoculation

LAB living population

Indigenous Lactic Acid Bacteria living population

Indigenous Brettanomyces sp. living population

Drain, press, rack 2 times after 12 and 60-72 hours

SO₂ addition as soon as malic is finished

Long Maceration GP

1 week
If we manage this microbial situation,

- Malolactic finishes in liquid phase, after draining, pressing, racking 2 times (after 12 and 60-72 hours): classical MLF Good Practices in liquid phase
- So, we take advantage of both long maceration and MLF good practices with coinoculation
- Without special practices due to the long maceration
As a sensory consequence, with coinoculation:

- **Yeast inoculation**
- **LAB (Lactic Acid Bacteria) coinoculation**
- **Indigenous Brettanomyces sp. living population**
- **Indigenous Lactic Acid Bacteria living population**

- **Cleaner**
- **More fruit**

- **Drain, press, rack 2 times after 12 and 60-72 hours**
- **SO₂ addition as soon as malic is finished**

1 week
With post-AF LAB (Lactic Acid bacteria) inoculation

Yeast inoculation

LAB inoculation, post AF

Selected LAB living population

Maceration

SO2 addition

Yeast living population

1 week

Yeast inoculation

Indigenous LAB living population

Indigenous Brettanomyces sp. living population

Drain, press, rack 2 times after 12 and 60-72 hours
With post-AF LAB inoculation

**Selected yeast active population**
- Applies a very intense ecological pressure on indigenous LAB and Brett

**The absence of a selected LAB population**
- Leaves an ecological space for indigenous LAB and Brett growth

**Indigenous Brettanomyces sp. living population**

**Indigenous LAB living population**

**Maceration**

**Selected LAB active population**
- Applies a very intense ecological pressure on indigenous LAB and Brett, but on a much higher population

**SO₂ addition**

**Drain, press, rack 2 times after 12 and 60-72 hours**
With post-AF inoculation

Yeast inoculation

LAB inoculation, post AF

Yeast living population

LAB inoculation, post AF

Indigenous Brettanomyces sp. living population

Indigenous LAB living population

Drain, press, rack 2 times after 12 and 60-72 hours

With extended maceration, very favorable growth conditions for Brett & Co.

Selected LAB living population

SO2 addition
As a sensory consequence, with post-AF inoculation

Yeast inoculation

Yeast living population

1 week

LAB inoculation, post AF

Selected LAB living population

Indigenous Brettanomyces sp. living population

Maceration

Indigenous LAB living population

Clean?

Clean?

Clean?

Drain, press, rack 2 times after 12 and 60-72 hours

SO2 addition
Question #1.
To assure a coinoculation and a long maceration:
Which pH recommendations?
Is it possible?
Which precautions other than pH?
Which sensory changes?
To assure a coinoculation and a long maceration:

Which pH recommendations?

< 3.51 all through maceration

Is it possible to co-inoculate and make a long maceration?

Yes, and quite easy with pH around 3.5

Which precautions other than pH?

Crush, temperature management (<26-27°C max.), sulfiting GP (<35 ppm added), yeast protection and nutrition.

Be sure to be absolutely sugar-dry during post-alcoholic maceration
Which sensory changes?

Classical direct positive effect of coinoculation:
more fruit and more balanced tannin-like sensations
+ The prevention effect of coinoculation on “Brett and Co” growth. So cleaner wines with better expression of fruit and less bitterness
+ The effect of possible MLF with the pomace: more complexity, more spicy with certain varieties. But less direct full fruit. So, it has to be managed in function of wine style and markets goals
Question #2.
How to manage LAB inoculation with over-15-days maceration?
Manage Good Practices to reach this situation

1 week

Yeast inoculation

LAB coinoculation

15-20 days maceration

SO2 addition

Yeast living population

LAB living population

Indigenous Brettanomyces sp. living population

Indigenous Lactic Acid Bacteria living population

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Main Good Practices to reach this situation

- < 3.51 all through maceration
- Coinoculation, AND
- Crush, sulfiting GP (<35 ppm added), LAB friendly yeast strain, yeast protection and nutrition, temperature management (<24-25°C max. during AF, 18-20°C after AF),
- Be sure to be absolutely sugar-dry during post-alcoholic maceration
- Forget many local traditions...
The best option to reach complexity, balance, longevity, and low volatile acidity

- Do a 15-20 days long maceration following the previous GP rather than a longer one (over 20 days) with “artificial” actions (to avoid spontaneous MLF and “Brett and Co”).
- “Artificial” actions =
  - Sulfiting during maceration to prevent malo and Brett growth. SO2 addition blocks many of the looked for reactions of a very long maceration
  - Lysozym addition. Reminder: no action on Brett
Reminder: in a Good Practices strategy, long maceration is only a tool, not a goal. There are very safe and high quality pathways to reach the announced goals for a “very long maceration”.

15-20 days maceration + co-inoculation + Dominique Delteil Consultant GP are better than a very long maceration without MLF GP
Question #3.
After a coinoculation, how to manage the end of malolactic fermentation if malic consumption occurs in the presence of the pomace cap?

Situation 1: sugars are completely consumed before the end of malic acid
Action #1. As soon as sugars are completely consumed:

- Make a delestage and in the drained wine, lower pH immediately to 3.50 maximum, if necessary. To go on favoring the selected LAB you co-inoculated
- Cool the wine to 18°C. To protect the fruit and avoid harsh tannin-like sensations development
- If necessary, add 1 g/hl Reduless and 10 g/hl Noblesse or Optilees. To open the aromas if necessary and to re-balance the colloid matrix if some aggressive sensations appear
- Pump the juice back to the maceration tank
- Make one delestage a day during the 2 following days. Total: 3 delestage in 3 days
Note: make these 3 recommended delestages even if you normally manage the pomace cap with other techniques (punching down, pumping over, submerged cap, etc.). Delestage is the only technique drains well the cap.
The action #1, right after alcoholic fermentation, is a key point to have the selected LAB population grow and consume malic in the absence of residual sugar. Then a moderate temperature and an adjusted pH complement this strategy.
Action #2. As soon as malic acid is consumed:

- Immediately: make a delestage. A real one with complete draining!
- Adjust pH immediately to 3.50 in the drained wine
- Add 50 ppm SO2 in the drained wine
- Cool the wine to 18°C maximum. For some grape varieties it is interesting to lower temperature to 12-14°C during post MLF extended maceration. Better fruit and more secure microbial situation
- Add 1 g/hl Reduless (to balance the SO2 addition impact) and 10 g/hl Noblesse or Optilees (to rebalance the colloid matrix)
- Pump the juice back to the maceration tank
Until final draining and pressing according to analytical profile and sensory style

- Check Volatile Acidity (VA), Total SO2, pH, residual sugar: 2-3 times a week
- Delestage: at least 2 times a week, eliminating the heavy lees settling at the bottom of the reception tank
- Temperature: 18°C max.
- If tannin-like sensations are aggressive, try a Reduless addition (1 g/hl) and Noblesse (10 g/hl) or Optilees.
Draining and pressing according to analytical profile and sensory style

- Drain, press, adding 1g/hl Reduless
- Adjust temperature to 12°C
- Keep press wines separate. Note: after very long maceration, press wines are often of lower quality than free run drained wine
- Rack after 12 hours
- Check pH, Total SO2, VA, sugar. Adjust pH and SO2 if necessary
- Rack again after 48 hours
Long maceration

As soon as the pomace cap is formed, coinoculation with selected LAB

Yeast inoculation

1 week

Brix and malic curves during a co-inoculated yeast - bacteria fermentation

Brix

Malic acid
Brix and malic curves during a co-inoculated yeast - bacteria fermentation

Yeast inoculation
As soon as the pomace cap is formed, coinoculation with selected LAB

Long maceration

24°C max.

1 week

18°C max.

Malic acid

Delestages: 3 in 3 days, adjust pH to 3.50

Delestage, adjust pH to 3.50, add 50 ppm SO2, pump back to maceration tank

Drain, press, add Reduless, rack 2 times (12 and 60-72 hours after draining)

10-12°C
Situation 2.
Malic acid is already finished before the end of sugar fermentation: see question #7
Question #4.
How to manage LAB inoculation if micro-oxygenation is necessary on structured reds?
Question #4.
How to manage LAB inoculation if micro-oxygenation is necessary on structured reds?

Micro-ox supplier question!
Question #4.
How to manage
Micro-oxygenation with a
Good Practices managed MLF?

Lallemand & DDC’s question!
Question #4.
How to manage
Micro-oxygenation with a
Good Practices managed MLF?

Do not confuse between means and objective!
Micro-oxygenation Good Practices with a structured red wine

- As soon as the pomace cap is formed, coinoculation with selected LAB
- Drain, press, rack 2 times
- Stir regularly the lees
- Malic acid
- Micro-oxygenation after MLF + sulfiting = 1/10th of pre-MLF dose
- Racking #4
- Stop

O₂ dose

20 days maceration

Brix

Yeast inoculation

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Exemple of micro-oxygenation doses, for a very structured red, expressed in mg/Liter/Month

Micro-oxygenation after MLF + sulfiting = 1/10\textsuperscript{th} of pre-MLF dose

- Brix
- Malic acid

0 3 2 1.5 1.0
Exemple of micro-oxygenation doses, for a very structured red, expressed in mg/Liter/Month

Micro-oxygenation after MLF + sulfiting = 1/10\textsuperscript{th} of pre-MLF dose

Micro-oxygenation Good Practices = optimization of the tool.
Not its maximalization pushed by some micro-ox gurus!
Dominique Delteil Consultant’s good practices.
Oxygen doses expressed in mg/Liter/Month

- Malic acid
- Brix
- Stop
- Racking #4

Oxygen doses:
- 30
- 20
- 10
- 5
- 0

1

Racking #4
Why?
Dominique Delteil Consultant’s good practices.
Oxygen doses expressed in mg/Liter/Month

- **Reduless 1 g/hl**
- **Reduless 1 g/hl**
- **Reduless 0.5 g/hl**

1. **Malic acid**
2. **Brix**
3. **Noblesse 10 g/hl**
4. **Noblesse 10 g/hl**
5. **Noblesse 10 g/hl**

**Racking #4**

Stop

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Dominique Delteil Consultant’s good practices.
Oxygen doses expressed in mg/Liter/Month

Early use of Reduless and Noblesse directly do better and more complete colloidal actions than higher micro-ox doses. Such micro-ox doses are sufficient.

Early use of Reduless and Noblesse allows to build and stabilize early a highly concentrated colloidal matrix. A shorter micro-ox duration with a lower dosage is sufficient to complement the matrix stabilization.

Reduless 1 g/hl
Reduless 1 g/hl
Reduless 0.5 g/hl
Noblesse 10 g/hl
Noblesse 10 g/hl
Malic acid
Stop

Diagram indicating the use of Reduless and Noblesse in wine-making processes.
Question #5.
Must we stop micro-oxygenation when MLF has started?
Answer #5.
YES
Why?
When to stop?
As soon as the pomace cap is formed, coinoculation with selected lactic acid bacteria. Very safe micro-ox. 

<30% of malic consumed. Stop micro-ox.

Brix and malic curves during a co-inoculated yeast - bacteria fermentation.
Another absolute key point: as soon as malic is consumed, racking and sulfiting

Yeast inoculation

As soon as the pomace cap is formed, coinoculation with selected lactic acid bacteria

Very safe micro-ox

Malic acid

Racking & Sulfiting

Stop micro-ox

Brix

1 week
As soon as the pomace cap is formed, coinoculation with selected lactic acid bacteria.
Another absolute key point: as soon as malic is consumed, racking and sulfiting.
As soon as the pomace cap is formed, coinoculation with selected lactic acid bacteria.

Close to the edge of abyss micro-ox!

90% of malic consumed

Stop micro-ox
As soon as the pomace cap is formed, coinoculation with selected lactic acid bacteria.

Another absolute key point: as soon as malic is consumed, racking and sulfiting.

1 week

Yeast inoculation

Brix

Malic acid

Close to the edge of abyss micro-ox!
Brix and malic curves during a co-inoculated yeast - bacteria fermentation

Yeast inoculation

As soon as the pomace cap is formed, coinoculation with selected lactic acid bacteria

Malic acid

Oops! Too late!

Stop micro-ox

1 week
Yeast inoculation

As soon as the pomace cap is formed, coinoculation with selected lactic acid bacteria

Never give oxygen to an *Oenococcus* living population once it has completely consumed malic: when it starts consuming intensely citric acid and some residual sugars there is a very high risk of Volatile Acidity (VA) and negative flavors production

Oops! Too late!
Question #6.
Is there a maximum amount of oxygen if I want to make micro-ox during the MLF?
Answer #6.

NO
Answer #6.
Polyphenolic concentration of the wine, stylistic goals and temperature pilot the amount of oxygen added.

MLF pilots when to start, stop, start again Micro-ox., along with sulfiting and rackings.
Question #7.
After a coinoculation, during a long red maceration, if MLF starts and finishes before the end of alcoholic fermentation, is it possible to go on macerating? Which particular precautions?
Answer #7.
Well, well, well, oh well !!!!
Don’t miss a single point!

- As soon as malic is finished, immediately: a delestage. A real one with complete draining!
- Adjust pH immediately to 3.45 in the drained juice
- Add 30 ppm SO2 in the drained juice
- Cool the juice to 18°C
- Add 1 g/hl Reduless (to balance the SO2 addition impact) and 10 g/hl Noblesse or Optilees (to help the living yeast finish the AF and rebalance the colloid matrix)
- Pump the juice back to the maceration tank
Don’t miss a single point (2)

• After a pumping over, check volatile acidity (VA), and Total SO2
• Everyday a delestage until the end of the sugars
• Keep temperature at 18°C
• Check everyday the remaining sugar level, the VA, the pH.
• If VA is rising, drain immediately, correct pH again to 3.40 and add another 20 ppm SO2. Rack 12 hours later to eliminate heavy lees (as they combine and bound SO2) and to homogenize well the SO2
After the end of alcoholic fermentation, if VA is still correct and stable

- Make a delestage
- Check pH is below 3.50. If not, adjust it
- Add 20 ppm SO2 in the drained juice
- Keep temperature around 18°C
- Add 1 g/hl Reduless (to balance the SO2 addition negative sensory impact) and 10 g/hl Noblesse or Optilees (to rebalance the colloid matrix affected by the SO2 addition)
- Pump the juice back to the maceration tank
Until final draining and pressing according to analytical profile and sensory style

- Check VA, Total SO2, pH: 2-3 times a week
- Delestage: at least 2 times a week, eliminating the heavy lees settling at the bottom of the reception tank
- Temperature: 18°C max.
- If tannin-like sensations are aggressive, try a Reduless addition (1 g/hl) and Noblesse (10 g/hl) or Optilees
Question #8.
Sometimes we have sugar released after the end of alcoholic fermentation in case of long maceration.
Is there a risk if I already inoculated with bacterias (VA ?)
Answer #8.
YES
The best strategy: avoid as much as possible this situation!
Key points to avoid Question #8, that is to avoid sugar release from the pomace after alcoholic is finished

• **Crush the fresh grapes.** To avoid any unopened berry during maceration

• **Add maceration enzymes.** To ease the diffusion of juice and sugar during the active Alcoholic Fermentation and to amplify deléstage efficiency in draining and slightly pressing the pomace

• **Good Practices for a steady and complete AF.** Adapt yeast strain choice, protection, and nutrition to juice sugar concentration
Key points to avoid Question #8 (2)

- **Regular Delestages.** At least 3 delestages a week during active AF: to drain perfectly the pomace juice and slightly press the berries, assuring a complete drainage of sugar.
Question #9.

Cold maceration. When to inoculate the bacteria if I aim for co-inoculation strategies?
Answer #9.
Apply cold maceration Good Practices
+
Long maceration Good Practices
Brix curve during cold maceration + classical maceration procedure applying Good Practices

1 week

4-5 days cold mac.

15-20 days maceration
Temperature management during cold maceration + classical maceration procedure

- 4-5 days cold mac. at 8-12°C
- 15-20 days maceration at 24°C max.
- 1 week
- 18-20°C
Actions during cold maceration + classical maceration procedure

Temperature adjustment, destem, crush, pH adjustment, SO2 (30 ppm max.), maceration enzymes, yeast protection, yeast inoculation, Optired

Fermaid O

8-12°C

4-5 days cold mac.

24°C max.

18-20°C

15-20 days maceration

1 week
**Actions during cold maceration + classical maceration procedure**

Temperature adjustment, destem, crush, pH adjustment, SO2 (30 ppm max.), maceration enzymes, yeast protection, yeast inoculation, Optired

**Fermaid O**

To ecologically limit the risks of apiculated yeast growth during the cold maceration:
An absolute key-point is to immediately inoculate with a protected (GoFerm Protect), temperature adapted selected yeast strain.
Malic curve during a co-inoculated yeast-bacteria fermentation, after a cold maceration

Temperature adjustment, destem, crush, pH adjustment, SO2 (30 ppm max.), maceration enzymes, yeast protection, yeast inoculation, Optired

As soon as the pomace cap is formed, coinoculation with selected lactic acid bacteria

- 4-5 days cold mac.
- 15-20 days maceration
- 8-12°C
- 24°C max.
- 18-20°C

Fermaid O

Malic acid

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Malic curve during a co-inoculated yeast - bacteria fermentation, after a cold maceration.

Temperature adjustment, destem, crush, pH adjustment, SO2 (30 ppm max.), maceration enzymes, yeast protection, yeast inoculation, Optired.

Note: Cold pre-fermentation maceration does not change the coinoculation good practices: As soon as the pomace cap is formed, coinoculation with selected lactic acid bacteria.

1 week

4-5 days cold mac.

8-12°C

24°C max.

15-20 days maceration

18-20°C

Brix

Malic acid
Post maceration and post MLF actions during a co-inoculated Cold + classical extended maceration

Temperature adjustment, destem, crush, pH adjustment, SO2 (30 ppm max.), maceration enzymes, yeast protection, yeast inoculation, Optired

Fermaid O
As soon as the pomace cap is formed, coinoculation with selected lactic acid bacteria

4-5 days cold mac.
15-20 days maceration

8-12°C
24°C max.
18-20°C

Drain, press, rack 2 times
Stir regularly

Malic acid
Racking #3, sulfiting GP

Brix
Special procedure for high quality Pinot Noir, with a full fruit style goal
High Quality full fruit Pinot Noir GP

Temperature adjustment, destem, crush, pH adjustment (3.3-3.4), SO2 (30 ppm max.), maceration enzymes, oak blocks, yeast protection, yeast inoculation
RC212, Optired

Fermaid O

As soon as the pomace cap is formed, coinoculation with selected LAB

Drain, press, rack 2 times (12 and 72 hours after draining)

Stir the lees regularly, keep pH <3.40

Racking #3, sulfiting GP

4-5 days cold mac.

10-12 days maceration

16°C

8-12°C

20°C max.

18°C

1 week

4-5 days cold mac.

10-12 days maceration

16°C

8-12°C

20°C max.

18°C

1 week
High Quality full fruit Pinot Noir GP

Temperature adjustment (3.3-3.4), SO2 (30 ppm max.), yeast protection, yeast inoculation

Drain, press, rack 2 times (12 and 72 hours after draining)

Stir the lees regularly, keep pH <3.40

Racking #3, sulfiting GP

4-5 days cold mac.

10-12 days maceration

Stir the lees regularly, keep pH <3.40

Temperature adjustment, destem, crush, pH adjustment (3.3-3.4), SO2 (30 ppm max.), yeast protection, yeast inoculation

RC212, Optired

As soon as the pomace cap is formed, coinoculation with selected LAB

Temperature adjustment, destem, crush, pH adjustment (3.3-3.4), SO2 (30 ppm max.), maceration enzymes, oak blocks, yeast protection, yeast inoculation

Note 1:
For full fruit high quality Pinot Noir, it is not recommended to macerate over 12-15 days. Longer maceration duration will bring more dry spicy and dryer tannin sensations, the opposite of the pre-fermentation maceration goals

16°C

18°C

10-12 days maceration

20°C max.

18°C

16°C

1 week

4-5 days cold mac.

10-12 days maceration

1 week

8-12°C

4-5 days cold mac.

10-12 days maceration

1 week

8-12°C

20°C max.

18°C

16°C

1 week

8-12°C

20°C max.

18°C

16°C

1 week

8-12°C

20°C max.

18°C

16°C

1 week

8-12°C

20°C max.

18°C

16°C

1 week

8-12°C

20°C max.

18°C

16°C

1 week

8-12°C

20°C max.

18°C

16°C

1 week

8-12°C

20°C max.

18°C

16°C

1 week

8-12°C

20°C max.

18°C

16°C

1 week

8-12°C

20°C max.
High Quality full fruit Pinot Noir GP

Temperature adjustment, destem, crush, pH adjustment (3.3-3.4), SO2 (30 ppm max.), temperature protection, yeast inoculation RC212, Optired

4-5 days cold mac.
8-12°C

1 week

10-12 days maceration
20°C max.

18°C

16°C

Racking #3, sulfiting GP

Note 2:
To achieve a full bodied, full fruit Pinot Noir with such temperature and maceration duration, an intense delestage (2 a day) and punching down (3 to 4 a day) program is the recommended procedure.

Stir the lees regularly, keep pH <3.40

4-5 days

1 week

10-12 days

20°C max.

18°C

16°C

Stir the lees regularly, keep pH <3.40

Racking #3, sulfiting GP

Note 2:
To achieve a full bodied, full fruit Pinot Noir with such temperature and maceration duration, an intense delestage (2 a day) and punching down (3 to 4 a day) program is the recommended procedure.

Stir the lees regularly, keep pH <3.40
High Quality full fruit Pinot Noir GP

Temperature adjustment, destem, crush, pH adjustment (3.3-3.4), SO2 (30 ppm max.), maceration enzymes, oak blocks, yeast protection, yeast inoculation (RC212, Optired)

As soon as the pomace cap is formed, coinoculation with selected LAB

Drain, press, rack 2 times (12 and 72 hours after draining)

Stir the lees regularly

Racking #3, sulfiting GP

16°C

4-5 days cold mac.

10-12 days maceration

8-12°C

20°C max.

Note 3:
As soon as significant malic degradation is detected, lower temperature to 16°C in order to protect the full fruit character. Such a temperature change won’t stop a well going on malolactic fermentation.