[WINE FERMENTATION USING GOFERMENTOR]

[FINAL REPORT]

2015

Index of contents

Introduction

The GOfermentor was developed by Dr. Vijay Singh, and is the result of four years of development by Dr. Singh to develop better winemaking technology that uses no wash water, excludes damaging air from the process, has integral cap management and pressing capabilities, and yet is cost-effective. Extensive trials and product development were performed at his own Sky Acres Winery in New Jersey. This winery exclusively uses the GOfermentor, and tests here were crucial in developing simple, yet reliable operating procedures.

GOfermentor brings groundbreaking technology to the age-old art of winemaking, providing greater control of fermentation parameters, minimal exposure to air, minimal use of water, and an integral-automated cap management system, resulting in better quality wine, every time.

Creates a sealed environment (which minimizes potential contamination) than fermentation in a macrobin. Moreover, the absence of oxygen allows the winemaker to have more control over the final quality of the product. Since GOfermentor requires no wash or rinse, its usage allow to reach a significant labor cost reduction.

The effectivity of realizing the wine fermentation must be evaluated by using this technology in order to obtain a wide range of characteristics related to wine quality.

Objective

Evaluate the effectiveness of realizing the wine fermentation with the system GOfermentor in terms of wine quality and savings of water and gases. In order to reach this objective we are going to realize different wine fermentations with this system and with the traditional system as well. At the end, the wine quality is going to be analyzed with both traditional analysis and with our trained tasting panel. In addition, the quantity of water and inert gases needed with both methods is going to be compared.

Experimental procedure

Six different wine fermentations were done; three with the system GOfermentor and three with the traditional system using the amounts and grape varieties specified below:

1. GOfermentor with 600 kg of Grenache noir
    a. Reference 15GOGN-GOGN
2. GOfermentor with 600 kg of Tempranillo
    a. Reference 15GOTE-GOTE
3. GOfermentor with 600 kg of Cabernet sauvignon
    a. Reference 15GOGS-GOGS
4. Wine microvinification with 50 kg of Grenache noir (x2)
    a. Reference 15GOGN-GNLL.1
    b. Reference15GOGN-GNLL.2
5. Wine microvinification with 50 kg of Tempranillo (x2)
    a. Reference 15GOTE-TELL.1
    b. Reference15GOTE-TELL.2
6. Wine microvinification with 50 kg of Cabernet sauvignon (x4)
    a. Reference 15GOGS- CSLL.1
    b. Reference15GOGS- CSLL.2
    c. Reference15GOGS- CSLL.3
    d. Reference15GOGS- CSLL.4

In all cases, the fermentation was inoculated with 1.5 x 10^6 cell/ml of LSA yeast DV10. The fermentation temperature was set at 20ºC. Sugar consumption was daily monitored by measuring the density (g/l) of the fermenting must. All fermentations were considered to be finished when the level of reducing sugars was below 2 g/l. The Cabernet sauvignon microvinifications were conducted without adding sulfur dioxide at any stage of the process.

During the fermentation all the water and inert gas used in both methods studied was measured. This information was complemented with the analysis of both labor and manpower costs.

Moreover, in the resulting wine were analyzed alcoholic degree, pH and concentrations of glucose, fructose, total acidity, acetic acid, malic acid, lactic acid, and free and total sulphur dioxide. All of them, including Turbidity in Nephelometric Turbidity Units (NTU) analyzed by

using the official European Method, will be analyzed following the procedure of the Office International de la Vigne et du Vin (OIV, 2008). All these parameters mentioned above are used for the characterization of the wines.

Furthermore, all those analysis were complemented with their organoleptic profile. The trained tasting panel of VITEC defined their visual, aromatic and taste characteristics of all them.

Schedule

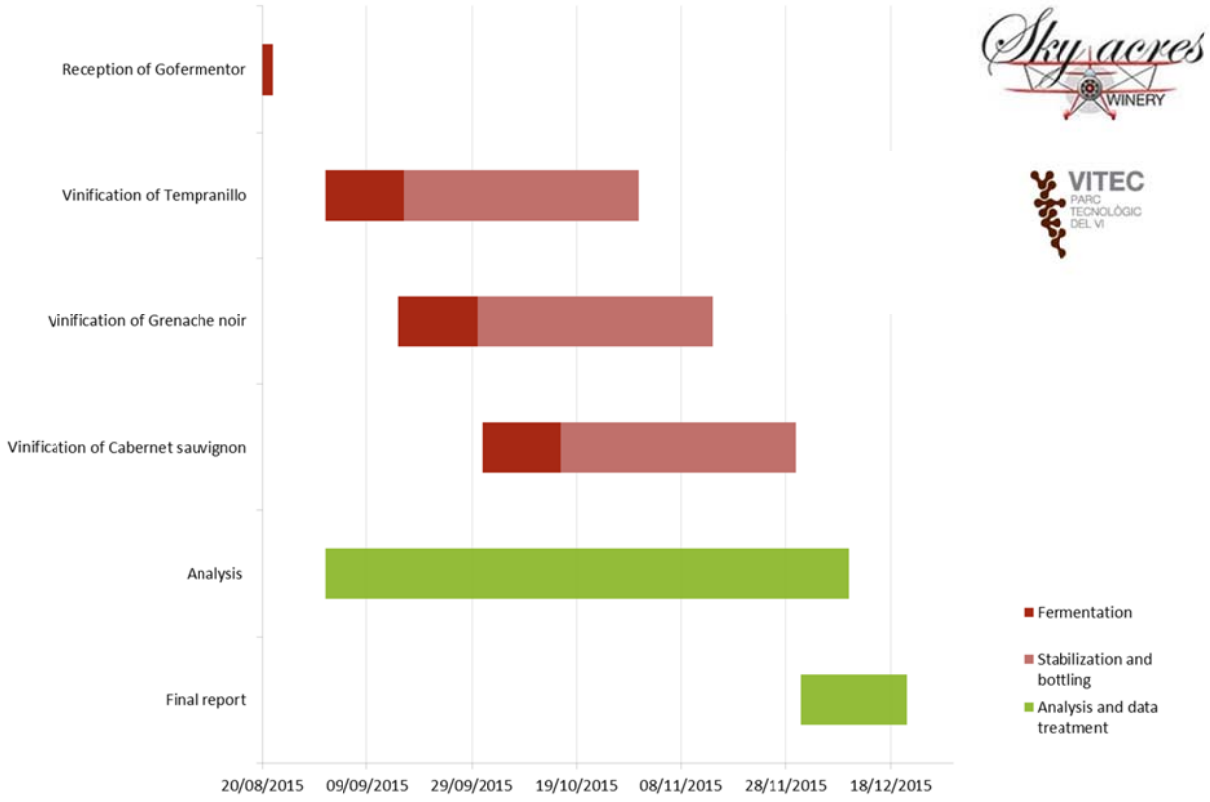

Figure 1. Schedule of the vinification processes.

Operational Results

Installation

The setting up of GOfermentor was rapid and easy.

The installation of GoBase was simple, we only needed to open the folded sides as the manual said. However, when we go to assemble the support rail and hose support pole to the control panel as figures shown, the ChepPalet was a little bit different from those on the manual.

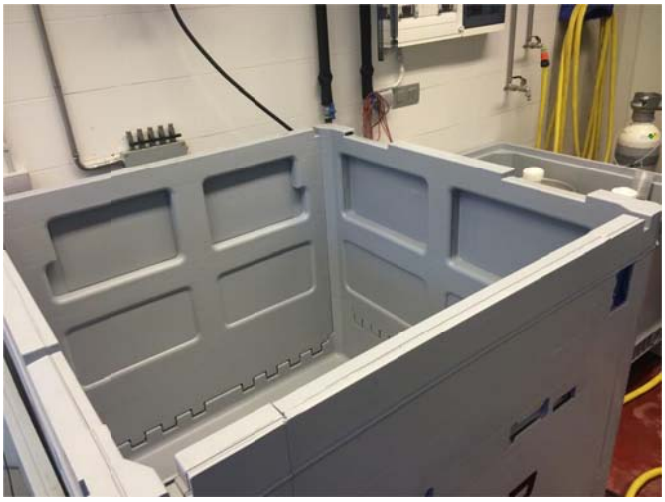

Figure 2. ChepPalet installed.

The installation of GoCooler was easy. We could not find any problem to connect the cooling plate and all the hoses. Although we think that the hoses are too fragile. It could be better changing it from those more flexible, in order to manipulate the GOfermentor easier. Furthermore, we would recommend the use of a rapid plug system, we spent 15 minutes in assembling the different hoses.

For the installation of Goliner we did not have any problem. We put the Goliner inside the Gobase and connect the different ports.

We found useful to find the different pieces marked with a reference in order to make the installation easier. One of the pieces we had not had a reference and then we spend a little bit more time to know where we need to put it.

Filling the Goliner with the must was trouble-free. Different colours in the bags help to quickly figure out the right position of the bag in Chep container, and the connections of all the hoses.

In our region, cellars do not usually have a MBS triclamp adaptor. Actually is more common to have the DN port. Then, it could be reasonable to have both ports or to have the option of choosing a DN adaptor.

Connecting the temperature probe/sampling tube was simple, the same as for the control panel. We found it easy to operate with the Basic controller panel. However, we have had

problems automatizing the punch system: we scheduled the punch system to perform at different hours, but the punch system did not work properly at first. Then, we learned it was because the GOfermentor needed you to validate both the hour and the minute fields.

Figure 3. Gofermentor installed.

At the end of alcoholic fermentation we obtained the "pressed" wine through the Gostrainer. The cover of the Gostrainer is made of plastic and it got broken when we use it several times. Furthermore the cover has a shape that makes it difficult to eliminate all the skins and wine.

The biggest problem was when we had to take out the Goliner at the end of alcoholic fermentation. The Goliner was too heavy to remove easily from the Chep pallet. Vitec do not have a forklift to facilitate this operation (as many cellars from our region). It could have been better if the Gobase allowed the panel to open towards outside the box.

The first time, the whole installation process took 40 minutes. Once the Gocooler and GOfermentor parts were assembled, only took 10 minutes to get ready the system for every new wine.

Process

Destemming and filling

There's no real difference between the GoFermentor and the traditional method regarding the destemming operation. Nevertheless, the portable design of the Gofermentor system offers more freedom of operation and might allow the process to be held in less space and using shorter hoses.

The Gofermentor filling does not require previous cleaning of the tank and the absence of air protects the musts of first stages oxidations.

Figure 3. Reception Tempranillo grapes.

Fermentation

This is the stage in which the GOfermentor stands beyond the traditional systems. All the operations needed for a proper fermentation are carried out by the equipment without human intervention, allowing saving personal costs.

Figure 4. Tempranillo alcoholic fermentation with Gofermentor system.

Pressing

There were obtained a yield around 65 % of wine for every must studied. To obtain this kind of yield without using a press is interesting in order to avoid cleaning the press system, which needs a lot of water.

Costs

While the experiment was going on we have already done a cost analysis linked to water and inert gas consumptions comparing GOfermentor technology with typical amounts of average wineries in Catalonia.

One 700 kg-grape charge of GOfermentor needs:

Table 1. Water and inert gas consumptions for a GOfermentor 700 kg charge

Process stage	Water consumption per GoF charge (liters)	%	Gas consumption per GoF Charge (liters)	%
Assembly	0,00	0%	0,00	0%
tank adaptation	90,00	14%	0,00	0%
Fill in (destemming and crushing phase)	300,00	48%	0,00	0%
Alcoholic fermentation	0,00	0%	0,00	0%
maceration after fermentation	0,00	0%	0,49	20%
Decanting	90,00	14%	1,23	50%
Pressing	0,00	0%	0,00	0%
Malo-lactic fermentation	0,00	0%	0,74	30%
Disassemble	150,00	24%	0,00	0%
Totals	**630,00**	**100%**	**2,46**	**100%**

Water analysis:

According to our experience, based in 35 water-consumption surveys and in 54 grape-volume surveys during 2007 and 2015, we can obtain that an average winery in Catalonia produces about 391.000 liters of wine and use 539 m^3 of water for cleaning.

According to these data we can obtain that a GOfermentor charge uses only the 0,12% of water demand for a winery during one wine harvest.

Going deeply, we can split GOfermentor water consumes per process stage, obtaining the following information (based on a 700 kg charge with a yield of 70%, so 490 liters of wine produced per charge):

Table 2. Ratios of liters of water waste and economic costs for every liter of wine produced using the GOfermentor system

Process stage	Water ratio (liter water/liter GoF wine)	%	Water ratio (€ water GoF/liter GoF wine)	%
Assembly	0,00	0%	0,00	0%
tank adaptation	0,18	14%	1,96E-04	14%
Fill in (destemming and crushing phase)	0,61	48%	6,53E-04	48%
Alcoholic fermentation	0,00	0%	0,00	0%
maceration after fermentation	0,00	0%	0,00	0%
Decanting	0,18	14%	1,96E-04	14%
Pressing	0,00	0%	0,00	0%
Malo-lactic fermentation	0,00	0%	0,00	0%
Disassemble	0,31	24%	3,27E-04	24%
Totals	**1,29**	**100%**	**1,37E-03**	**100%**

According to our experience linked to last audits done to wineries, the average ratio liters of water used per liters of wine produced this value is 3,48. So, GOfermentor procedure uses a 63,10% less of water than an average winery. On other words, to spend 1€ of water, using GOfermentor, is necessary to produce 729 liters of wine or 952 units of 0,75 liters of wine bottled.

In terms of costs, in Catalonia each cubic meter of water costs 1,07€ so the ratio of cost of water (€) per liter of wine produced by GOfermentor technology is about 1 cent of Euro.

Inert gas analysis:

On the other hand, analyzing inert gas consumptions, as showed in Table 1, there is shown per process stage the total amount of inert gas needed for one 700 kg GOfermentor charge.

According to our experience and based on an average winery placed in Catalonia used around 39 bottles of inert gas per year, which means around 1.966 liters. Each bottle cost without taxes represent an average price of 50€ per each 50,4 liters of inert gas.

That means that one charge uses only the 4,89% of the gas of one bottle as well as the 0,13% of the total need of inert gas in a year for an average Catalan winery.

In the following table it is shown the ratio calculated using the same basis as for water:

Table 3. Ratios of liters of gas waste and economic costs for every liter of wine produced using the GOfermentor system

Process stage	Gas Ratio (liter gas/liter GoF wine)	%	Gas Ratio (€ Gas/liter GoF wine)	%
Assembly	0,00	0%	0,00	0%
tank adaptation	0,00	0%	0,00	0%
Fill in (destemming and crushing phase)	0,00	0%	0,00	0%
Alcoholic fermentation	0,00	0%	0,00	0%
maceration after fermentation	1,00E-03	20%	9,89E-04	20%
Decanting	2,51E-03	50%	2,47E-03	50%
Pressing	0,00	0%	0,00	0%
Malo-lactic fermentation	1,51E-03	30%	1,48E-03	30%
Disassemble	0,00	0%	0,00	0%
Totals	**5,02E-03**	**100%**	**4,94E-03**	**100%**

From this table we can deduce that to expense 1€ of inert gas it is necessary to produce 202 liters of wine using GOfermentor technology, in other words, to bottle 149 wine 0,75 liter-bottles.

Analytical Results

Analysis of musts

Tempranillo

Table 4. Analysis of Tempranillo musts.

Must Sample	Total acidity (g/l tartaric acid)	Brix	TAP (% vol)	pH	Sugar (g/l)	Amonium (mgNH4/L)	PAN (mgN /L)	YAN (mgN/L)
15GOTE-TELL.1	3.6	22.9	13.5	3.8	225.2	16	40.7	53.18
15GOTE-TELL.2	3.5	22.8	13.4	3.7	224.1	23	34.8	52.74
15GOTE-GOTE	3.5	22.4	13.1	3.7	219.5	25	35.9	55.40

The Tempranillo musts presented a total acidy around 3.5 g/l, pH of 3.7 and GAP around 13.5. The content of Nitrogen was adjusted to the minimum required by yeasts fermentation adding Enovit (ammonium phosphate, ammonium sulfate, thiamine and adjuvant), the amount of total nitrogen needed was 180 mg/l of Nitrogen.

Grenache noir

Table 5. Analysis of Grenache noir musts.

Must Sample	Total acidity (g/l tartaric acid)	Brix	TAP (% vol)	pH	Sugar (g/l)	Amonium (mgNH4/L)	PAN (mgN/L)	YAN (mgN/L)
15GOGN-GNLL.1	4.1	25.5	15.5	3.7	261	60	89.7	136.5
15GOGN-GNLL.2	4.1	25.6	15.7	3.6	265	55	71.6	114.5
15GOGN-GOGN	3.9	25.5	15.5	3.6	263	46	90.1	125.98

The Grenache noir musts presented a total acidy around 4 g/l, pH of 3.7 and GAP around 15.5. The content of Nitrogen was adjusted to the minimum required by yeasts fermentation adding Enovit (ammonium phosphate, ammonium sulfate, thiamine and adjuvant), the amount of total nitrogen needed was 210 mg/l of Nitrogen.

Cabernet sauvignon

Table 6. Analysis of Cabernet sauvignon musts.

Must Sample	Total acidity (g/l tartaric acid)	Brix	TAP (% vol)	pH	Sugar (g/l)	Amonium (mgNH4/L)	PAN (mgN/L)	YAN (mgN/L)
15GOCS-CSLL.1	4.1	25.6	14.7	3.6	256.4	82	81.2	145.16
15GOCS-CSLL.2	4.0	25.7	14.7	3.6	257.8	76	78.3	137.58
15GOCS-CSLL.3	4.7	26.2	15.1	3.5	263.8	89	81.3	150.72
15GOCS-CSLL.4	4.7	25.7	14.7	3.5	257.8	103	87.0	167.34
15GOCS-GOCS	4.0	25.7	14.7	3.6	257.8	83	80.9	145.64

The Cabernet sauvignon musts presented a total acidy around 4 g/l, pH of 3.5 and GAP around 14.7. The content of Nitrogen was adjusted to the minimum required by yeasts fermentation adding Enovit (ammonium phosphate, ammonium sulfate, thiamine and adjuvant), the amount of total nitrogen needed was 205 mg/l of Nitrogen.

Evolution of alcoholic fermentation

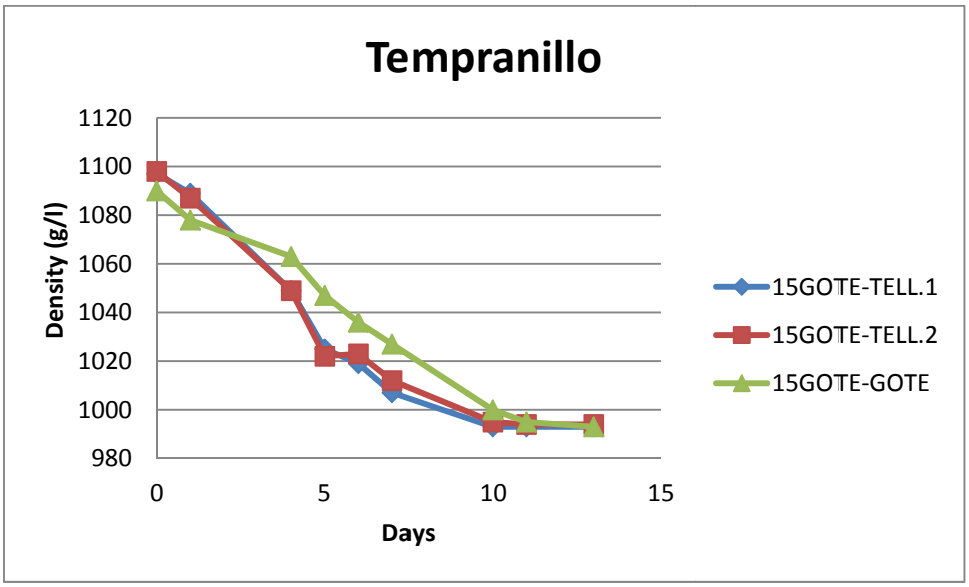

Figure 5. Density vs. Fermentation time in Tempranillo alcoholic fermentation.

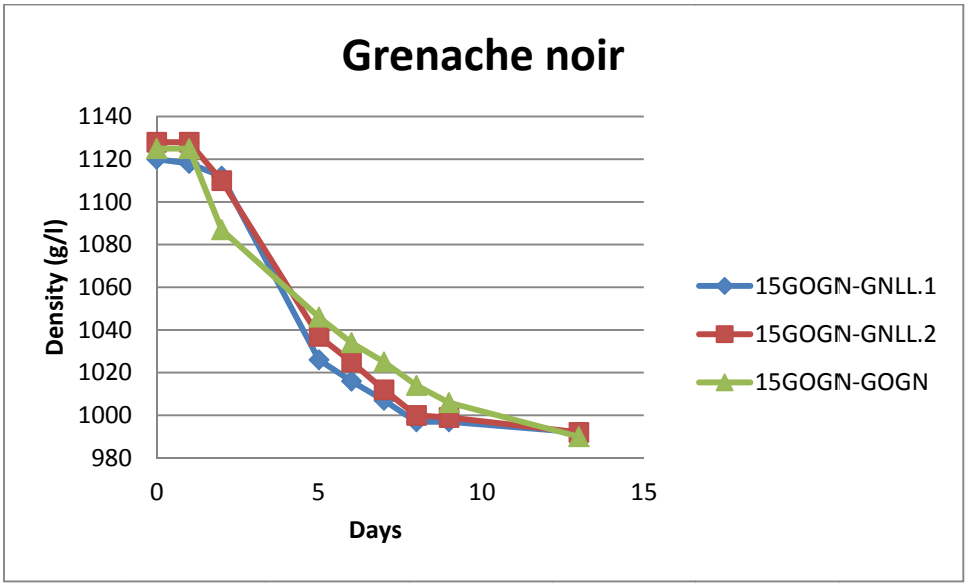

Figure 6. Density vs. Fermentation time in Grenache noir alcoholic fermentation.

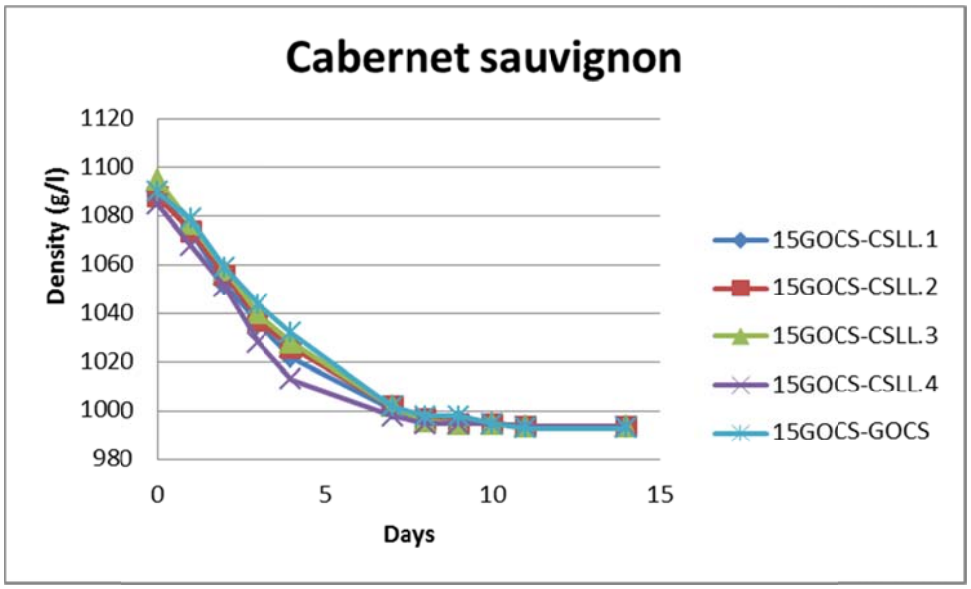

Figure 7. Density vs. Fermentation time in Cabernet sauvignon alcoholic fermentation.

The three different fermentations were done properly and consume all the sugars in less than 15 days. For the Cabernet sauvignon fermentation the process needed between two and three days more than the other ones. There were not differences between the traditional and GOfermentor system in terms of alcoholic fermentation.

Evolution of malolactic fermentation

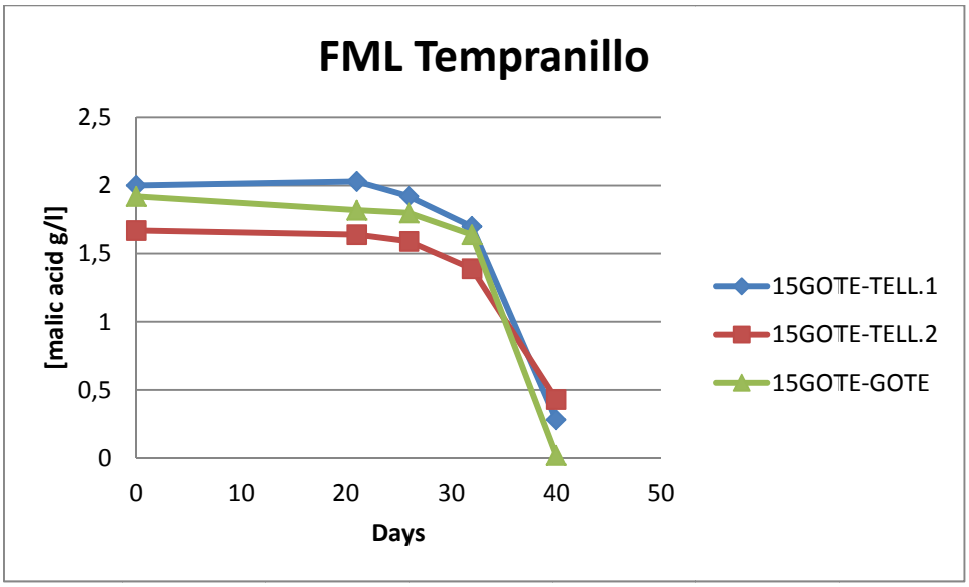

Figure 8. Malic acid vs. Fermentation time in Tempranillo malolactic fermentation.

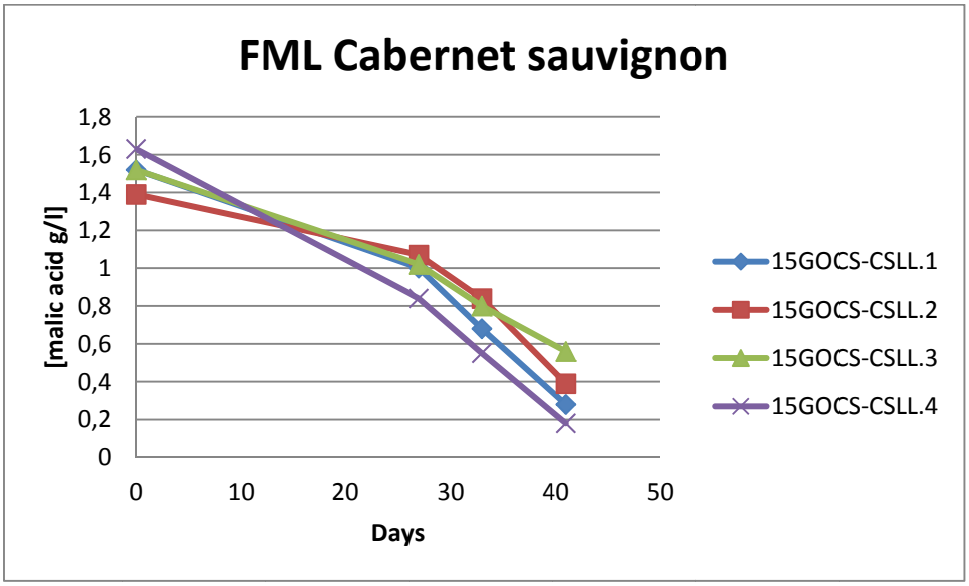

Figure 9. Malic acid vs. Fermentation time in Cabernet sauvignon malolactic fermentation.

Tempranillo and Cabernet sauvignon musts had done the malolactic fermentation properly. Although the Grenache noir must did not have sufficient amount of malic acid to conduct the malolactic fermentation. There were not differences between the traditional and GOfermentor system in terms of malolactic fermentation.

Analysis of wines

Tempranillo

Table 7. Analysis of Tempranillo wines

Wine Sample	Free SO_2 (mg/l)	Total SO_2 (mg/l)	Acetic acid (g/l)	Malic acid (g/l)	Lactic acid (g/l)	Glucose + Fructose (g/l)	Alcoholic degree (% vol.)	Total acidity (g/l Tartaric acid)	pH	NTU
15GOTE-TELL.1	20	48	0.08	0.10	2.00	0.11	14.0	4.9	4.1	0.3
15GOTE-TELL.2	18	46	0.11	0.10	1.67	0.12	14.2	4.7	3.9	0.2
15GOTE-GOTE	14	109	0.09	0.17	1.79	0.08	13.7	4.7	3.9	9.2

Wine Sample	Absorbance							Cie-Lab coordenade						
	420	450	520	570	620	630	280	L*	C*	h*	a*	b*	Int.	Ton.
15 GOTE-TELL.1	2.6	2.7	3.8	2.8	0.8	0.6	62.4	21.1	63.55	31.82	54.00	33.51	7.147	0.680
15 GOTE-TELL.2	2.8	3.0	4.3	3.1	0.9	0.6	64.5	20.1	62.83	31.81	53.40	33.12	7.949	0.649
15 GOTE-GOTE	3.6	4.2	5.9	4.7	1.6	1.1	61.4	10.4	45.22	23.28	41.54	17.87	11.06	0.710

The Tempranillo wines presented a standard alcoholic degree around 14 % vol. in terms of the wines produced in DOQ Priorat. However, the pH values were a little bit high. In general, there were not differences between the traditional and GOfermentor system. However, in terms of color the color profile of Gofermentor system obtained better profile and intensity.

Grenache noir

Table 8. Analysis of Grenache noir wines

Wine Sample	Free SO2 (mg/l)	Total SO2 (mg/l)	Acetic acid (g/l)	Malic acid (g/l)	Lactic acid (g/l)	Glucose + Fructose (g/l)	Alcoholic degree (% vol.)	Total acidity (g/l Tartaric acid)	pH	NTU
15GOGN-GNLL.1	11	29	0.14	0.12	0.46	0.10	16.5	5.0	3.5	1.1
15GOGN-GNLL.2	10	29	0.15	0.12	0.49	0.11	16.7	6.0	3.3	0.9
15GOGN-GOGN	24	59	0.33	0.12	0.52	0.51	16.7	6.0	3.4	0.8

Wine Sample	Absorbance							Cie-Lab coordenade						
	420	450	520	570	620	630	280	L*	C*	h*	a*	b*	Int.	Ton.
15 GOGN-GNLL.1	1.7	1.9	3.5	2.0	0.4	0.2	52.0	33.0	76.82	31.01	65.84	39.58	5.518	0.483
15 GOGN-GNLL.2	1.9	2.2	4.2	2.4	0.4	0.3	55.8	30.6	78.27	33.99	64.90	43.75	6.538	0.466
15 GOGN-GOGN	2.3	2.6	4.1	2.5	0.6	0.4	58.3	26.6	73.07	35.19	59.72	42.11	7.041	0.586

The Grenache noir wines presented a high alcoholic degree, superior than 16 % vol., this values did not represented a problem during the alcoholic fermentation and all of them finished properly the fermentation. In this case, the pH values were the expected to carry out these alcoholic fermentations. In general, there were not differences between the traditional and GOfermentor system. However, in terms of color the color profile of Gofermentor system obtained better profile and intensity as in Tempranillo wines.

Cabernet sauvignon

Table 9. Analysis of Cabernet sauvignon wines

Wine Sample	Free SO_2 (mg/l)	Total SO_2 (mg/l)	Acetic acid (g/l)	Malic acid (g/l)	Lactic acid (g/l)	Glucose + Fructose (g/l)	Alcoholic degree (% vol.)	Total acidity (g/l Tartaric acid)	pH	NTU
15GOCS-CSLL.1	0	0	0.11	0.07	1.52	0.14	15.6	5.4	3.6	27.0
15GOCS-CSLL.2	0	0	0.15	0.07	1.39	0.13	16.5	6.1	3.6	15.4
15GOCS-CSLL.3	0	0	0.14	0.08	1.52	0.13	15.6	6.2	3.5	36.4
15GOCS-GOCS	0	0	0.18	0.06	1.22	0.24	16.0	6.3	3.6	20.5

Wine Sample	Absorbance							Cie-Lab coordenade						
	420	450	520	570	620	630	280	L*	C*	h*	a*	b*	Int.	Ton.
15 GOCS-CSLL.1	3.52	3.9	5.9	3.8	1.0	0.7	52.4	17.3	58.42	30.50	50.34	29.65	10.70	0.629
15 GOCS-CSLL.2	3.54	3.9	6.1	3.8	1.0	0.7	54.0	18.7	61.48	31.45	52.44	32.08	10.86	0.618
15 GOCS-CSLL.3	3.58	4.0	6.3	3.9	1.0	0.7	52.4	18.7	61.59	31.43	52.55	32.12	11.19	0.613
15 GOCS-GOCS	4.10	4.6	6.5	4.0	1.1	0.8	54.3	16.2	56.38	29.64	49.00	27.88	12.20	0.707

The Cabernet sauvignon fermentations were conducted without adding sulfur dioxide. This fact did not influence in the sanity of the wines, getting wines with less than 0.2 g/l of acetic acid. As the Grenache noir wines, high alcoholic degree were obtained, superior than 15.5 % vol. These values did not represent a problem during the alcoholic fermentation and all of them finished properly the fermentation. The pH values were the expected to carry out these alcoholic fermentations. In general, there were not differences between the traditional and GOfermentor system. However, in terms of color the color profile of Gofermentor system obtained better profile and intensity as in Tempranillo and Grenache noir wines.

Sensory analysis of wines

· Comparison between GOfermentor and traditional system:

Table 10. Color evolution and intensity of the Tempranillo wines.

	Color Evolution	Color Intensity
15GOTE-GOTE	4.312 a	3.672 a
15GOTE-TELL	3.733 b	2.850 b
Pr > F	0.015	0.001
Significative	Yes	Yes

Each value is between 0 minimum and 5 maximum.

Table 11. Color evolution and intensity of the Grenache noir wines.

	Color Evolution	Color Intensity
15GOGN- GOGN	3.670 a	2.403 a
15GOGN- GNLL	3.795 a	2.235 a
Pr > F	0.396	0.418
Significative	No	No

Each value is between 0 minimum and 5 maximum.

Table 12. Color evolution and intensity of the Cabernet sauvignon wines.

	Color Evolution	Color Intensity
15GOCS-GOCS	3.305 a	4.020 a
15GOCS-CSLL	3.533 a	3.733 a
Pr > F	0.152	0.314
Significative	No	No

Each value is between 0 minimum and 5 maximum.

In terms of color, significative differences were only observed between the **T**empranillo wines (GOfermentor vs Microvinification) through the sensorial tasting conducted by the trained panel of Vitec. The wine obtained from GOfermentor vinification was more intense and less oxidized than the one made with Vitec's traditional microvinification system.

Tempranillo

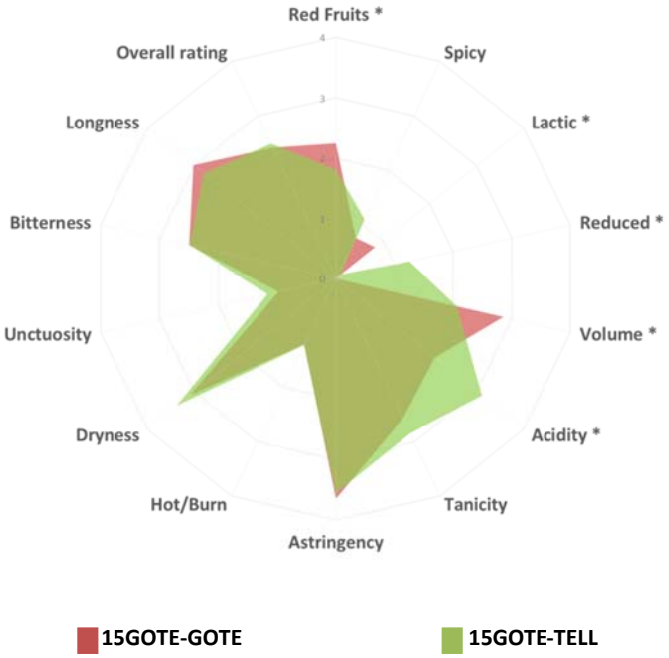

Figure 10.- Tempranillo: Comparison of aroma profile and mouthfeel between GOfermentor and microvinification sytem.

The GOfermentor wine showed a more typical Tempranillo profile, with higher rates in red fruits and lactic aroma, while the microvinificated wine was spicier and present a little bit reduction. In this case, there was no difference between the overall ratings obtained by the two wines.

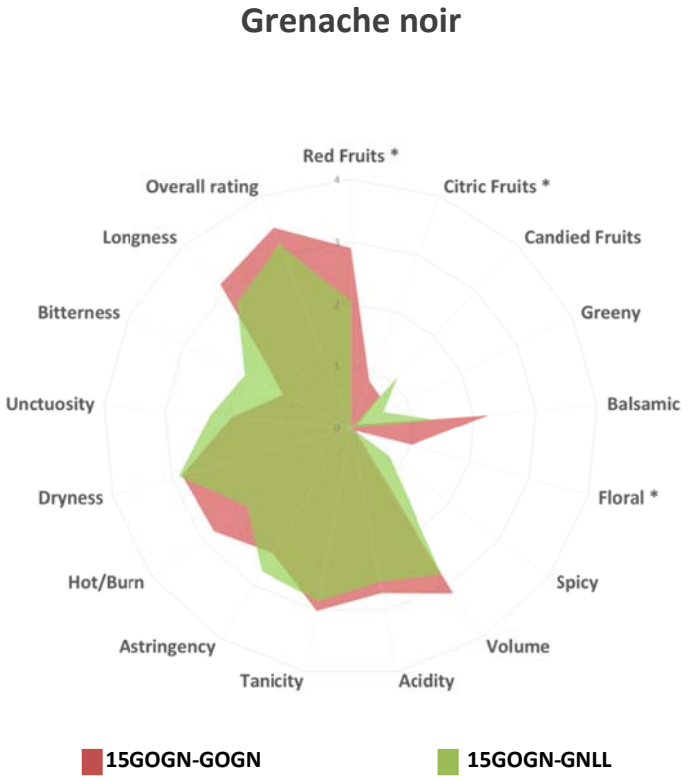

Figure 11. Grenache noir: Comparison of aroma profile and mouthfeel between GOfermentor and microvinification sytem.

In terms of aroma profile, GOfermentor wine showed a freshly profile, with more red and citric fruits, balsamic and floral aroma. The microvinificated wine had a heavier profile with candied fruits, greeny aroma and spicy. In terms of mouthfeel, GOfermentor wine was less bitter and unctuous, but it burned the mouth more than the microvinificated wine. GOfermentor wine obtained a better overall rating.

Cabernet Sauvignon

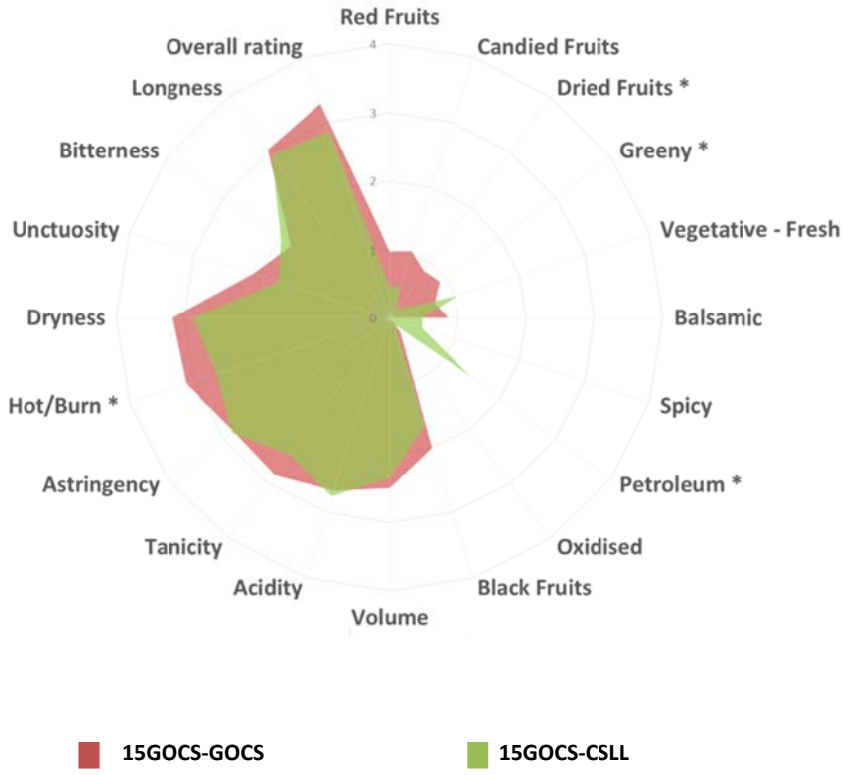

Figure 12. Cabernet sauvignon: Comparison of aroma profile and mouthfeel between GOfermentor and microvinification sytem.

GOfermentor wine obtained higher ratings for almost every attribute evaluated, except for both petroleum and vegetative descriptors. GOfermentor wine obtained a better overall rating.

· General profile of the three grapes varieties:

Table 13. Color evolution and intensity of the wines made with GOfermentor system.

	Color Evolution	Color Intensity
15GOTE-GOTE	4,312 a	3,672 a
15GOGN-GOGN	3,670 b	2,403 b
15GOCS-GOCS	3,305 b	4,020 a
Pr > F	0,000	0,000
Significative	Yes	Yes

Each value is between 0 minimum and 5 maximum.

In terms of color intensity and evolution the three wines are quite representative of what could be expected from each grape variety: very intense Cabernet sauvignon and Tempranillo, in contrast with less colored Grenache noir. All three wines present a normal color evolution regarding their vintage.

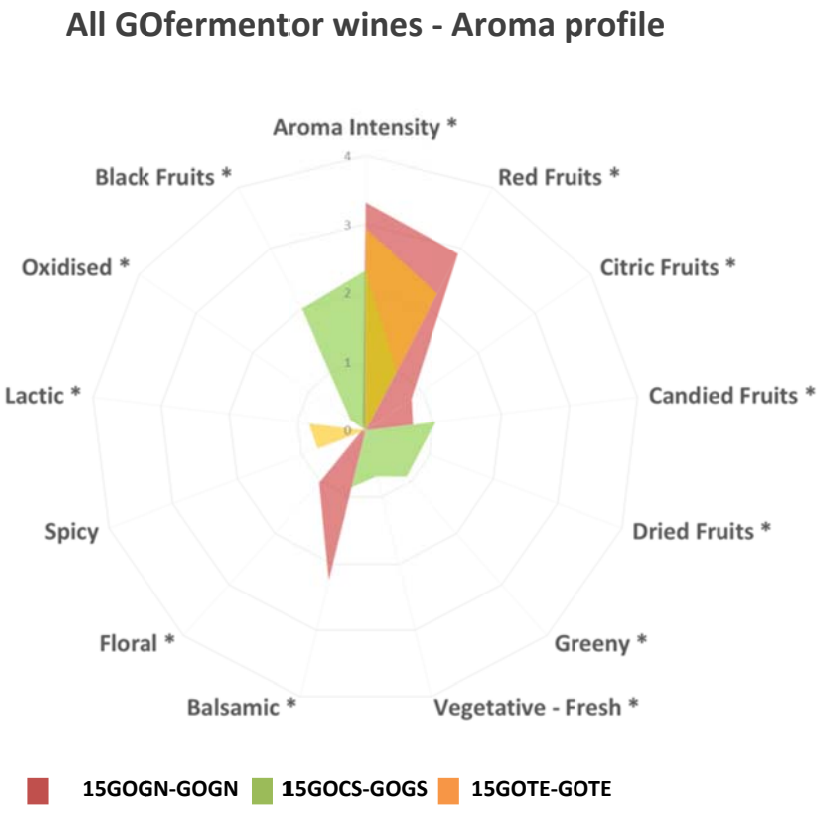

Figure 13.- Aroma profile of the wines made with GOfermentor sytem. The significative attributes are marked.

Grenache noir is especially intense in red fruits, flora and balsamic aroma. Cabernet sauvignon is characterized by having aroma of black fruits and both greeny and vegetative aromas.

Tempranillo stands out for lactic and spicy aromas, as well as some red fruits. All three wines show the typical profile of their grape varieties.

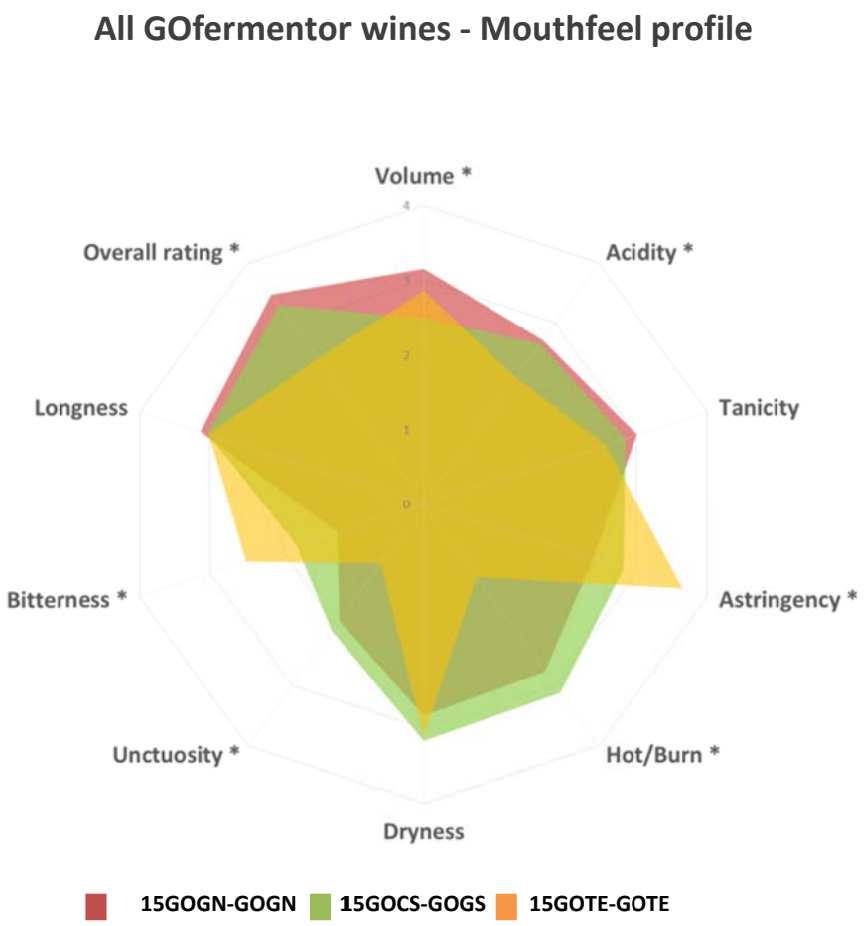

Figure 14.- Mouthfeel profile and overall rating of the wines made with GOfermentor sytem. The significative attributes are marked.

None of the wines presented any deviation in terms of mouthfeel. All of them are intense and with hard mouth, as expected in non-finished wines.

Final Conclusions

As for the installation and the process, the installation of GOfermentor was easy by following the instructions supplied. In general, the alcoholic fermentation carried out by GOfermentor system did not presented any kind of problem. This system avoid the presence of oxygen in contact with wine and this allow to prevent any kind of oxidations, however this may present problems of reduced environment and their associated components. Additionally, the GOfermentor can be used to press the wine once alcoholic fermentation has finished. The probes carried out showed efficiencies values around 65%. The results obtained show less efficiency than those obtained from standard pressing systems (hydraulic or pneumatic press), but they are in a good range in terms of the wines made in the region of Priorat.

Concerning the waste and costs associated conducting the fermentation with GOfermentor, this procedure allows avoiding to clean and to inertize the tank. Furthermore, it reduces considerably the personal tasks during alcoholic fermentation, avoiding conducting the pigeages needed per day. The GOfermentor procedure used 63% less of water than an average winery, and no inert gas was used during the stages that took place into the GOfermentor system. 729 liters of wine produced with GOfermentor system have an associated cost of 1 Euro of water waste, compared with 2.7 euros spent with the traditional system.

With reference to the evaluation of the wines through the trained tasted panel, the Cabernet sauvignon and Grenache noir wines obtained by GOfermentor procedure presented a better overall rating. The Tempranillo wines obtained by GOfermentor and traditional procedure did not present differences in the overall rating. In general, all the wines produced with GOfermentor present more red fruits than the ones produced with our microvinification process. The color extraction with GOfermentor system was appropriate, obtaining wines with a good color. Furthermore, the sensory analysis of Tempranillo wines showed significant differences in terms of color evolution and color intensity, indicating that the one produced with GOfermentor procedure obtained better scores on both attributes. Even so, microvinification and GOfermentor systems have a different profile in terms of passive oxygen supply, so this color results could change in the future due to stability issues.

Regarding the Cabernet sauvignon wines produced in GOfermentor without adding sulfur dioxide: all of them get a good sanity without any microbiological problem and no oxidation has been noticed until now, almost two month after finishing the fermentation. The sensory panel considered them as high quality wines and much better than the microvinificated ones.

Enhancement options

- The system could be improved adding some gadget for the addition of oxygen or oenological products to the wine during the fermentation. The manual should advice the lack of oxygen related to the system too.

- The system of taking out the Goliner from the ChepPalet at the end of maceration stage can be improved. A small winery can find difficult removing the bag from the base without a proper forklift.

- An explanatory scheme in the manual regarding the whole run off process would be good too.

- There is a bug in the program that runs in the controller panel that needs to be fixed: some scheduled punchings appear marked as active while they are not, because the program needs the user to validate each time field (even when they are the pre-defined '00 o'clock hours)

- We would recommend some changes in the GoCooler design in order to reduce the required assemblage time and reinforce the provided hoses.