„PETAINER Trial“

Impact of bottling and storing wine in Petainer, Kegs, Glas bottles on analytical and sensory properties on german white and red wine

Report after 12 months of storage

Bottling Experiment dated 11th September 2013

At 18.10.2013 you received the report of the bottling experiment with a german white and red wine, vintage 2012, using different types of containers for storage under controlled conditions in our institute. The containers were stored according to the test schedule at 22-25°C and at 15°C.
The wines used in the trial were:

1 **Müller-Thurgau Qualitätswein trocken**
Vintage 2012

2 **Rotwein, Sortencuvée trocken**
Vintage 2012

Both wines were bottled into:

	White- / Redwine
1	Petainer
2	Stainless-Steel-Keg
3	Glasbottle

According to the experimental plan the wines out of the different containers were examined after several time points for analytical and sensorial parameters. This report shows the results of these analysis **after 12 months of storage** for white and red wine which were stored **at 15°C**.

Examinated Parameters

1 Visual Description of container conditions and sampling

The correct sealing of the bottles and possible leakage problems in all containers were checked. Also a description of the tapping of samples should be done here.

2 **Colour intensity** (E420+E520+E620)

Colour change can be used as a further indicator to monitor the development of wine. Oxidation processes always have an influence on the colour of a beverage. The analysis of colour was done with a „Dr. Lange, CADAS 200 Spectrum Photometer“ on wavelengthes between 420nm and 620nm. The colour intensity is defined as the sum of the Extinctions at 420, 520 and 620nm

3 Sulphur dioxide content in the wines (influence of oxygen/oxidation)

From the sulphur dioxide consumed which is consumed from the wine conclusions on the oxygen transmission rate of the packaging or closures can be drawn.

The sulphur dioxide (free and totals) was measured using an FIA Star Wine Analyser. The detection thresholds of the method are 0.6 mg/l for free sulphur dioxides and 1.5 mg/l total sulphur.

4 Comparative sensory testing of the samples

To test the differences between the wines bottled and stored in different containers "ranking tests" and also a “triangle tests” were conducted. These difference tests were done with support of “FIZZ” sensory software and trained panelists from Hochschule Geisenheim University.

RESULTS

1 Visual Description of container conditions and sampling

The visual examination of the containers did not show any deviation concerning leakage. All containers stored at 22-25°C and 15°C were closed correctly.

The sampling method was done in the way that 2 Liters were tapped before the sample of 0,75 L / container was taken for analysis. The used pressure gas was nitrogen.

2 **Colour intensity** (E420+E520+E620)

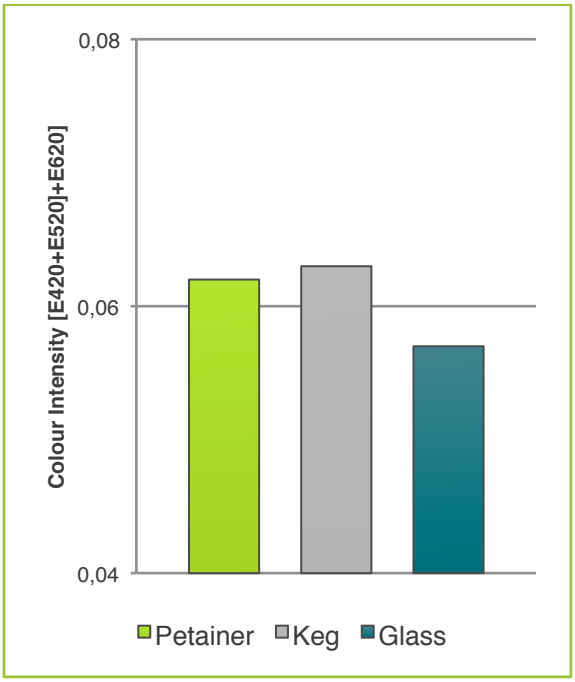
After the storage period of 12 Months only small differences in colour intensity for the white and the red wines stored in different containers could be observed. Tendencially the wines stored in Glass bottles had a lower colour intensity. This difference could be measured analytically but was not significant in sensory as can be shown later.

White Wine, cool storage
Colour Intensity

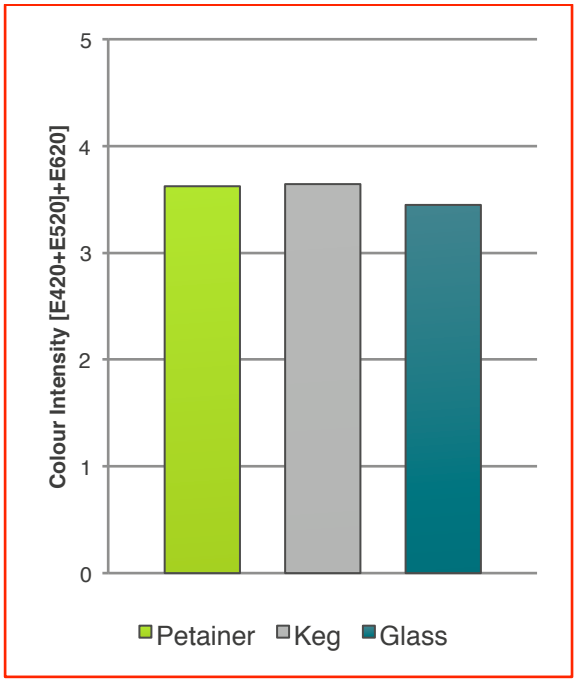
Variant	(n)	Average
Petainer	6	0,062
Keg	6	0,063
Glass	20	0,057

Red Wine, cool storage
Colour Intensity

Variant	(n)	Average
Petainer	6	3,624
Keg	6	3,644
Glass	20	2,449



White Wine, Colour Intensity after 12 months of cool storage



Red Wine, Colour Intensity after 12 months of cool storage

3 Sulphur dioxide content in the wines (influence of oxygen/oxidation)

The consumption of sulphur dioxide is an indicator for the oxidative or reductive situation in the wine and the oxygen transmission through the packaging or closures. The less oxygen is transferred into the wine from the bottling, the headspace and through the packaging or closure, the less sulphur dioxide is indirectly consumed to reverse oxidativ processes in the wines.

The content of SO_2 at the time point of bottling for the **White wine** was 56 mg/L free SO_2 and 134 mg/L total SO_2. For the **Red wine** the content of free and total SO_2 were 43 mg/L free respectively 140 mg/L total sulphuric acid.
After 12 months of storage the contents of free and total sulphur dioxide were analysed in the wines of all containers.

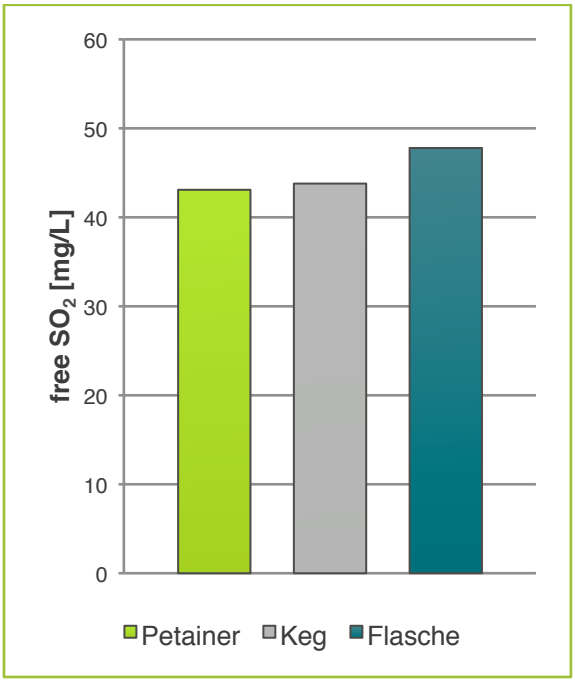
In the following graphs and tables the average values for each PETAINER and Keg (out of 6 single samples) and glass bottles (out of 20 single samples) are documented. First all values examined for the white wine at the different storage temperatures (warm: 22-25°C, cold: 15°C) are shown, in the second part all results from the examinations of the red wines and both storage conditions are presented.

White Wine, cool storage
free SO_2 [mg/L|

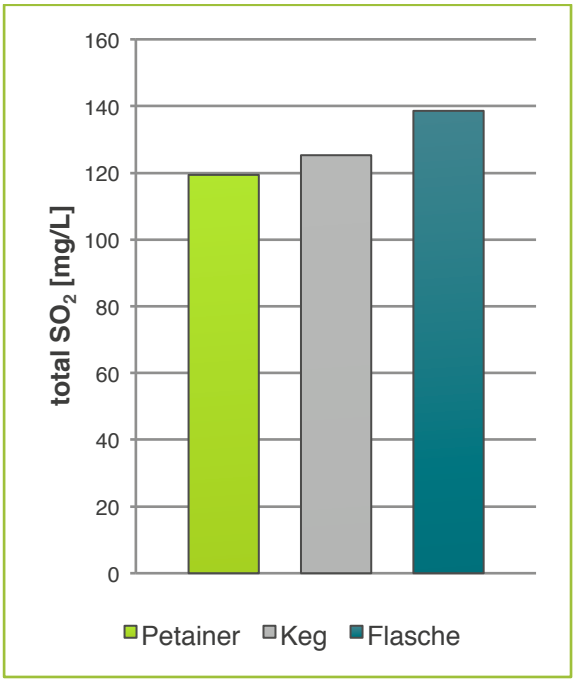
Variant	(n)	Average
Petainer	6	43,1
Keg	6	43,8
Glass	20	47,8

White Wine, cool storage
total SO_2 [mg/L|

Variant	(n)	Average
Petainer	6	119,4
Keg	6	125,3
Glass	20	138,6



White Wine, *free* SO_2 after 12 months of cool storage



White Wine, *total* SO_2 after 12 months of cool storage

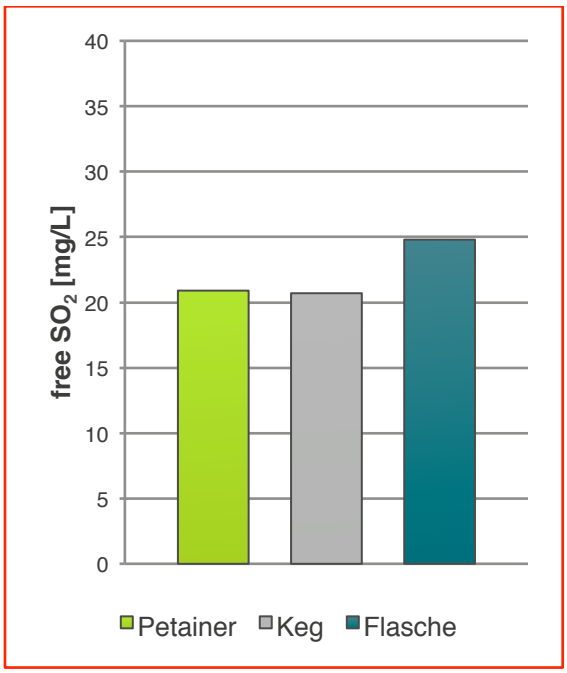
Comparing the **free and total SO_2-contents in the white wines** the wines from the PETAINER compared to the other containers it is obvious, that after 12 months of storage at 15°C the samples in glass bottles had the highest contents resp. the lowest loss in free and total SO_2. In all containers the contents of free sulphuric acid was higher than 40 mg/L which is high enough to prevent the wine from oxidation.

Red Wine, cool storage
free SO_2 [mg/L|

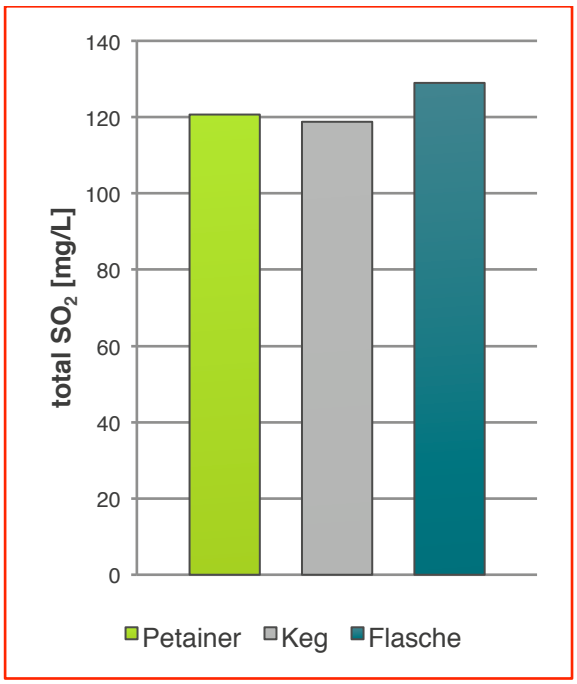
Variant	(n)	Average
Petainer	6	20,9
Keg	6	20,7
Glass	20	24,8

Red Wine, cool storage
total SO_2 [mg/L|

Variant	(n)	Average
Petainer	6	120,7
Keg	6	118,8
Glass	20	129,0



Red Wine, free SO_2 after 12 months of cool storage



Red Wine, total SO_2 after 12 months of cool storage

Comparing the **free and total SO_2-contents in the red wines** the wines from the PETAINER and stainless steel kegs showed little lower contents in free and total SO_2 compared to the samples out of Glass bottles.

Again in any case, the absolut content of free (>20 mg/L) and total SO_2 (>120 mg/L) in the red wine after 12 months of storage at 15°C were still high enough to prevent the wine from oxidation.

5 Comparative *sensory testing* of the samples

Sensory analysis was done at Hochschule Geisenheim University with a trained panel and the use of “FIZZ Biosystemes” sensory software.

For the tasting after 12 months different samples from the storage at 15°C were selected. The tastings took place on 31st of October 2014 with 17 panellists.

For the analysis of differences between the wines from bottling and storage in different containers, the testing methods "***Ranking***" and **“Triangle-Test”** were selected.

Rank testing allows for comparison of several products alongside one another. This method is described in DIN (German Industry Norm) 10963, ISO 8587, and in § 35 of the German food and grocery law (LMBG, Method 00.60 4). Using rank testing, two or more samples can be placed in order according to a predefined criteria.

Test procedure:
The testers receive two or more samples to test in random order. The samples are then sorted by the testers into a prescribed order. The sorting criteria is predefined (e.g. sweetness, acidity, fragrance intensity) and the testers then assign places to the individual samples. Via computer support, the samples are labelled with random three-digit codes and given to the testers in random order.

Statistical Analysis:
Results of the taste test are statistically analysed using a calculation process prescribed by the DIN (German Industry Norm).

The first test is called the "***F-Test***" (Friedmann-Test). This test verifies whether the test panel is generally able to recognize statistically significant differences between individual samples in a ranking test. If the testers have recognized the differences between the samples, their results can be guaranteed correct to a level of 95%, 99% or 99,9%, depending on the "F Value" the team displays.
If the result of this test is not conclusive, no further calculations can be carried out.

If the F-Test shows that the testers are generally able to recognize significant differences between the samples, a second calculation test will be carried out. It is called the "**Sample Comparison**" test. The samples between which the testers can recognise significant differences are identified. The result of this second calculation then clarifies whether or not these testers are able to differentiate, for example in a test of four products, between Sample A and B, A and C, A from D, B from C, and so on. The calculation process defines again whether a recognised difference between two samples can be guaranteed 95% or 99%.

Results „Ranking Test“

White Wine, Red Wine 2012

In two ranking tests with each 3 samples the wines out of the different containers (Petainer, Keg, Glass) were directly compared by sensory.

The panellists had the task to bring the samples into an order concerning the parameter „freshness“. The samples which showed the maximum „freshness“ (fruitiness, CO_2 mouthfeel) in comparison should get „Place 1“, the following samples places 2 and 3.

The following rankings were judged by 17 Panellists for **cool** (15°C) stored white and red wines of the different packaging variants.

	Sample 1	**Sample 2**	**Sample 3**
Ranking 1, White Wine, cool storage	Petainer 12 months	Keg 12 months	Glass 12 months
Ranking 2, Red Wine, cool storage	Petainer 12 months	Keg 12 months	Glass 12 months

The result of the ranking is summarized in the following table.

Ranking 1, White Wine, cool storage			
	Petainer 12 months	Keg 12 months	Glass 12 months
Sum of ranks	34	36	32
Significance	0,7903 **not significant**		

Ranking 2, Red Wine, cool storage			
	Petainer 12 months	Keg 12 months	Glass 12 months
Sum of ranks	38	31	33
Significance	0,4655 **not significant**		

After 12 months of storage at 15°C the panellists could ***not find significant differences between*** the ***white and red wines*** stored in different containers.

In order to document eventually occuring differences between the different bottled and stored white and red wines with a stronger difference test **„Triangle-Tests“** were conducted with the panel.

This method of a direct sensory comparison is particularly useful in situations where treatment, processing or packaging effects may have influences on the product.

During the tasting three coded samples are given to the panellists. Two of those three samples are identical and one is different. The task for the panellists is to find the different (odd) sample without having any advice concerning the background of difference between the samples (e. g. samples from different packaging). After the test the number of correct samples (panellists who found the different samples) are counted.
The panellists got the samples for the triangle tests randomized in the order shown in the table below.

	Wine / storage	**Sample 1**	**Sample 2**
Triangletest 1	**White Wine**, **cool storage**	Petainer 12 months	Glass 12 months
Triangletest 2	**White Wine**, **cool storage**	Petainer 12 months	Keg 12 months
Triangletest 3	**Red Wine**, **cool storage**	Petainer 12 months	Glass 12 months
Triangletest 4	**Red Wine**, **cool storage**	Petainer 12 months	Keg 12 months

The following table shows the results oft he sensory triangle tests produced with „Fizz Biosystemes“ sensory software.

	Sample 1	Sample 2	Answers taken	Answers right	Significance (Risk)
Triangletest 1 White Wine, cool storage	Petainer 12 months	Glass 12 months	17	7	0,3261
Triangletest 2 White Wine, cool storage	Petainer 12 months	Keg 12 months	17	11	0,0080**
Triangletest 3 Red Wine, cool storage	Petainer 12 months	Glass 12 months	17	3	0,9558
Triangletest 4 Red Wine, cool storage	Petainer 12 months	Keg 12 months	17	8	0,1719

According to DIN 10951 in a panel with 17 panellists at least 10 members of the panel have to detect the odd sample in the triangle to define a sensory difference between the samples. If 10 panellists find the odd sample in the triangle it can be concluded that a significant difference between the samples could be found on a 95% significance level. To have a higher significance 11 right answers are necessary for 99% significance and 13 right answers are necessary for 99,9% significance (see also following table).

Number of Judges (Answers taken)	Number of right answers that are necessary for a certain level of significance		
	* 95% Signif.	** 99% Signif.	*** 99,9% Signif.
n = 17	10	11	13

The Panellists detected significant differences between the wines stored in different containers in one of the 4 conducted triangle tests.
In this triangle 11 panellists out of the 17 judges in total were able to differentiate the wine out of Petainer from the wine stored in Stainless Steel Kegs.

The panellists were also asked for the preferred product in the case that a difference between two samples could be detected. The following table shows the result for this question for preference in triangle 2.

Table of the preferred product

	Answers Taken	Product	Answers	Signif. (Risk)
Triangletest 2 White Wine, warm storage	11	Petainer 12 months	7	0,5488
		Glass 12 months	4	

The further conducted test of preference showed that 7 Panellists preferred the wine stored in Petainer while 4 Panellists preferred the wine out of Stainless Steel Keg. A statistically significant difference for this could not be calculated.