

## Consolidated English Report

### **ANALYSIS REPORT AFTER 12 MONTHS STORAGE TIME**

#### **Storage trial dated Mai 31<sup>th</sup> 2011**

At 31.05.2011 you received the report of the storage experiment for a still and sparkling **Riesling trocken, Vintage 2010**, using different types of containers for storage under controlled conditions in our institute. The containers were stored according to the test schedule at 15°C and 22-28°C.

As described in the test schedule the wines were stored in the following container types:

	Still wine	Sparkling wine
1	KeyKeg	KeyKeg
2	Glass	Glass
3	Bag in Box	Keg

After the filling procedure the wines in different containers were controlled for several analytical and sensorical parameters during the storage period. Analyses were done after 3, 6 and 12 months. The following report contains the data for the longest storage period of **12 months**. After 12 months the containers from cool storage (15°C) were analysed. Additionally the containers that had been opened after 6 months were controlled for a second time (6 months opened).

## **ANALYTICAL PARAMETERS**

- 1 Visual description of the containers and bottles**
  
- 2 Analytical measurement of CO<sub>2</sub> (Sparkling wine)**
  - Measurement for Key-Keg, Keg with Haffmanns CO<sub>2</sub>/O<sub>2</sub>-Gehaltemeter
  - Measurement for Glass bottles with Mettler Toledo
  
- 3 Colour intensity (E420+E520+E620)**
  
- 4 Sulphur dioxide content in the wines (influence of oxygen/oxidation)**
  - free and total SO<sub>2</sub> with FIA star 5000
  
- 5 Comparative sensory testing of the samples**
  - Difference tests with Ranking
  - Difference tests in Triangles

## RESULTS

In this consolidated report the most important results from analysis after 12 months of storage, partly also with containers which were opened 6 months before, are shown in a compact form.

### 1 Visual description of containers and bottles

No obvious problems concerning leakage for any container could be detected.

### 2 Analytical measurement of CO<sub>2</sub> (Sparkling wine)

The following table and chart show the CO<sub>2</sub> contents in the sparkling wine stored in different containers. Also the effect of containers which were open for 6 months are shown besides fresh opened variants.

The content of CO<sub>2</sub> at filling was 4,5 g/L.

Sparkling wine, storage at 15°C CO <sub>2</sub> [g/L]			
Variant	Samples (n)	Average	
KeyKeg 12M	6	4,26	
KeyKeg 6+6ML	3	4,39	
KeyKeg 6+6MC	2	4,26	
Keg 12M	4	4,51	
Keg 6+6M	4	4,50	
Glassbottle* 12M	2	3,45	

\* 12 M = 12 months fresh opened container

6+6 M = opened after 6 months, analysed again after 12 months

L = air between PET and Bag in KeyKeg

C = CO<sub>2</sub> between PET and Bag in KeyKeg

Glass = CO<sub>2</sub> measurement with different analyser

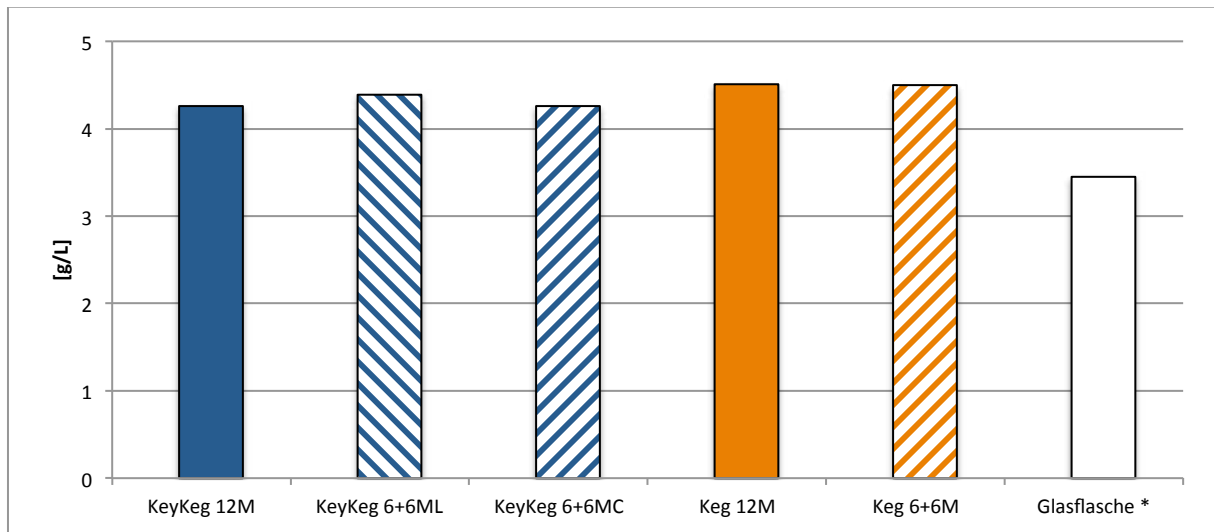


Abb.1: CO<sub>2</sub> – Contents after 12 Months 15°C (\* different analyser)

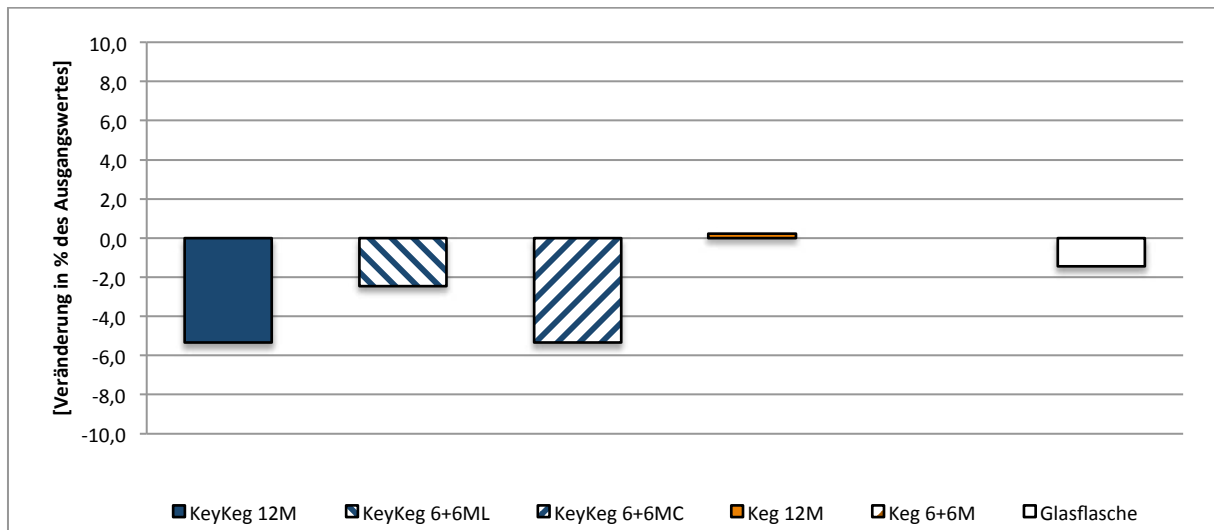


Abb.2: CO<sub>2</sub> – Difference of CO<sub>2</sub> content from time of filling to 12 months

The results show, that the content of Carbon dioxide decreased only in a low level. All containers, also containers stored opened were adequate to store the sparkling wine for the time period of 12 months storage.

### 3 Colour intensity (E420+E520+E620)

After 12 months of storage the lowest colour intensity was measured in the wines in glass bottles. The following tables and charts show the results for still- and sparkling wine.

Still wine, 15°C Colour intensity		
Variant	Samples (n)	Average
KeyKeg 12M	6	0,110
KeyKeg 6+6ML	4	0,098
KeyKeg 6+6MC	2	0,098
Bag in Box 12M	4	0,118
Bag in Box 6+6M	4	0,115
Glassbottle 12M	8	0,077

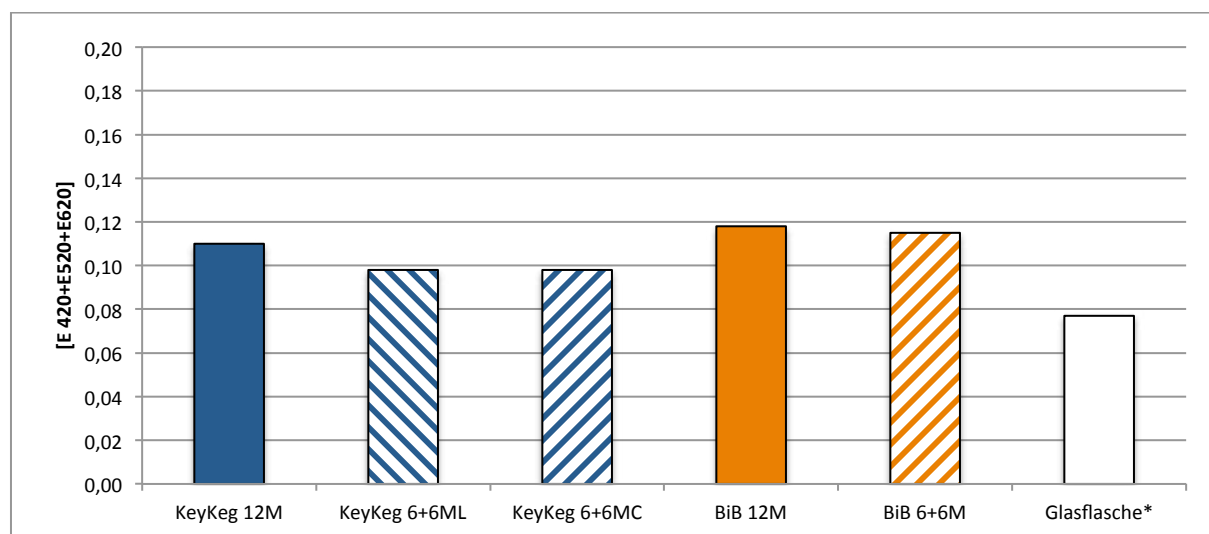


Abb.3: Still wine, Colour intensity after 12 Months 15°C

Sparkling wine Colour intensity			
Variant	Samples (n)	average	
KeyKeg 12M	6	0,106	
KeyKeg 6+6ML	3	0,094	
KeyKeg 6+6MC	2	0,102	
Keg 12M	4	0,105	
Keg 6+6M	4	0,111	
Glassbottle* 12M	6	0,091	

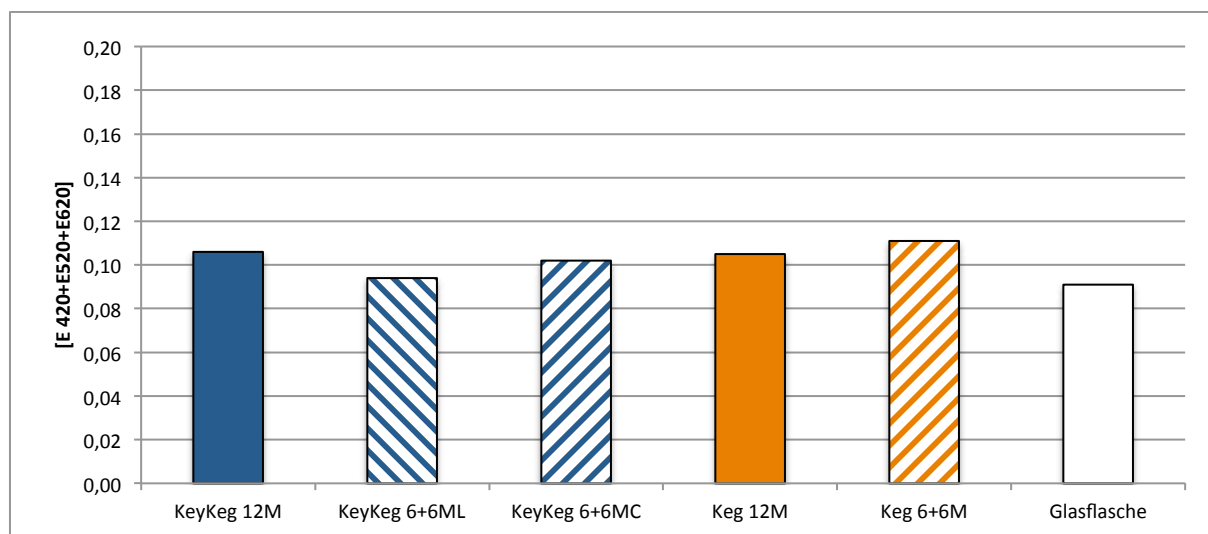


Abb.4: Sparkling wine, Colour intensity after 12 Months 15°C

#### 4 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 closures.

The less oxygen is transferred into the wine from the bottling, the headspace and through the closure or container, the less sulphur dioxide is consumed by oxidation.

In the following graphs and tables, the average values of the analysis of **still wines** are shown in comparison.

Still wine, 15°C SO <sub>2</sub> - free [mg/L]		
Variant	Samples (n)	Average
KeyKeg 12M	6	39,8
KeyKeg 6+6ML	4	38,8
KeyKeg 6+6MC	2	40,7
Bag in Box 12M	4	18,8
Bag in Box 6+6M	4	16,8
Glassbottle 12M	8	51,0

Still wine, 15°C SO <sub>2</sub> - total [mg/L]		
Variant	Samples (n)	Average
KeyKeg 12M	6	117,6
KeyKeg 6+6ML	4	121,8
KeyKeg 6+6MC	2	127,4
Bag in Box 12M	4	97,9
Bag in Box 6+6M*	4	93,3
Glassbottle 12M	8	139,2

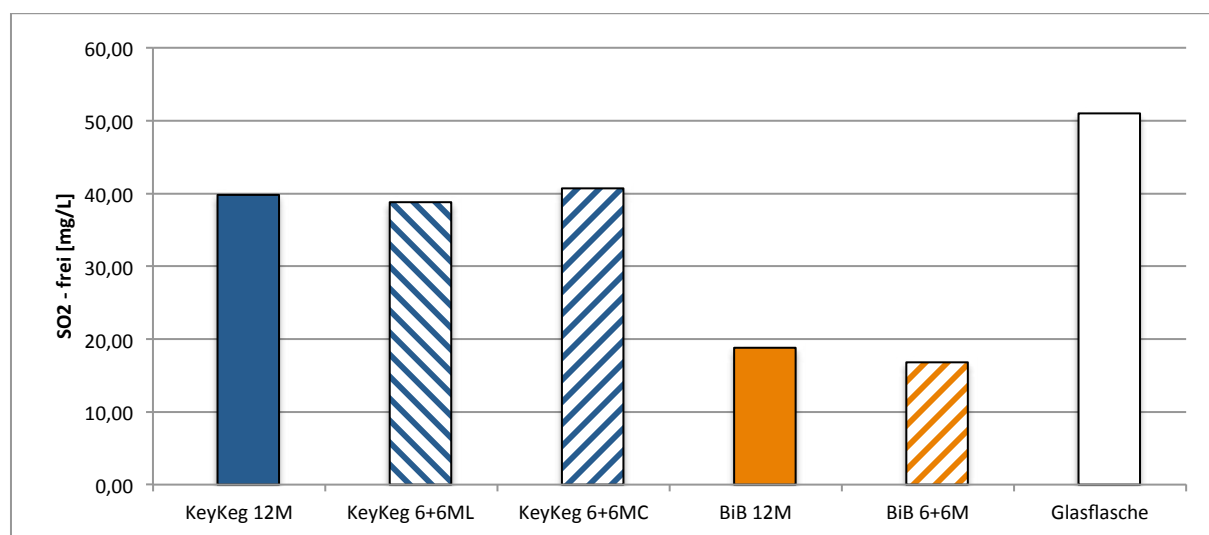
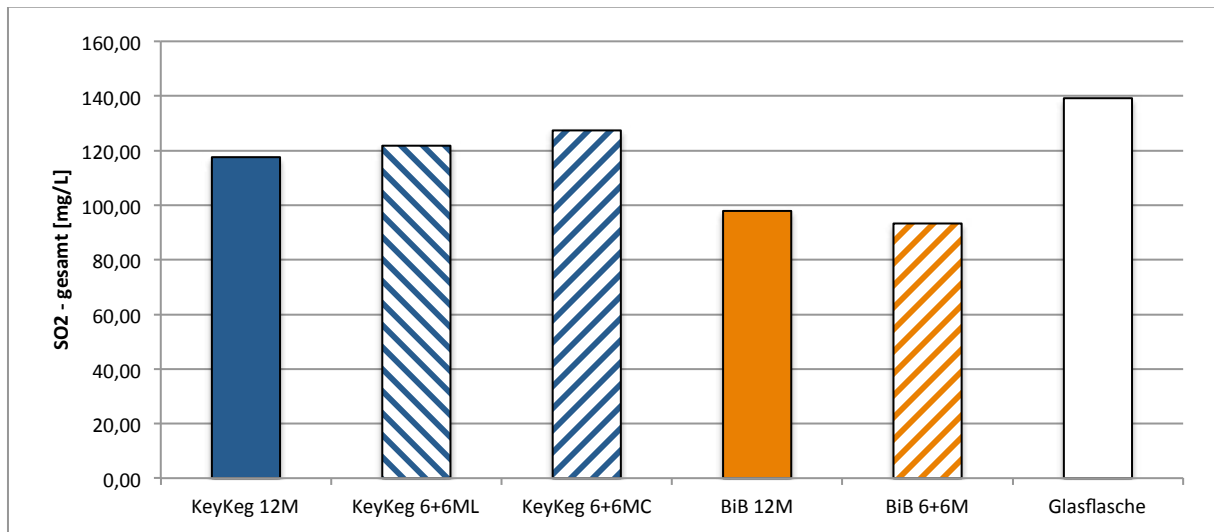


Abb.5: Still wine, free SO<sub>2</sub> after 12 Months 15°C



**Abb.6: Still wine, free SO<sub>2</sub> after 12 Months 15°C**

As shown in the table the still wines stored in Bag in Box Containers showed the highest decrease of SO<sub>2</sub>. The lowest decrease was measured for the wines in Glass bottles.



The following tables and charts show the contents of free and total SO<sub>2</sub> for the **sparkling wines**.

Sparkling wine, 15°C SO <sub>2</sub> - free [mg/L]		
Variant	samples (n)	Average
KeyKeg 12M	6	35,9
KeyKeg 6+6ML	4	31,5
KeyKeg 6+6MC	2	38,1
Keg 12M	4	41,4
Keg 6+6M*	4	41,5
Glassbottle 12M	8	49,5

Sparkling wine, 15°C SO <sub>2</sub> – total [mg/L]		
Variant	samples (n)	Average
KeyKeg 12M	6	119,3
KeyKeg 6+6ML	4	115,0
KeyKeg 6+6MC	2	123,2
Keg 12M	4	127,0
Keg 6+6M*	4	129,6
Glassbottle 12M	8	142,1

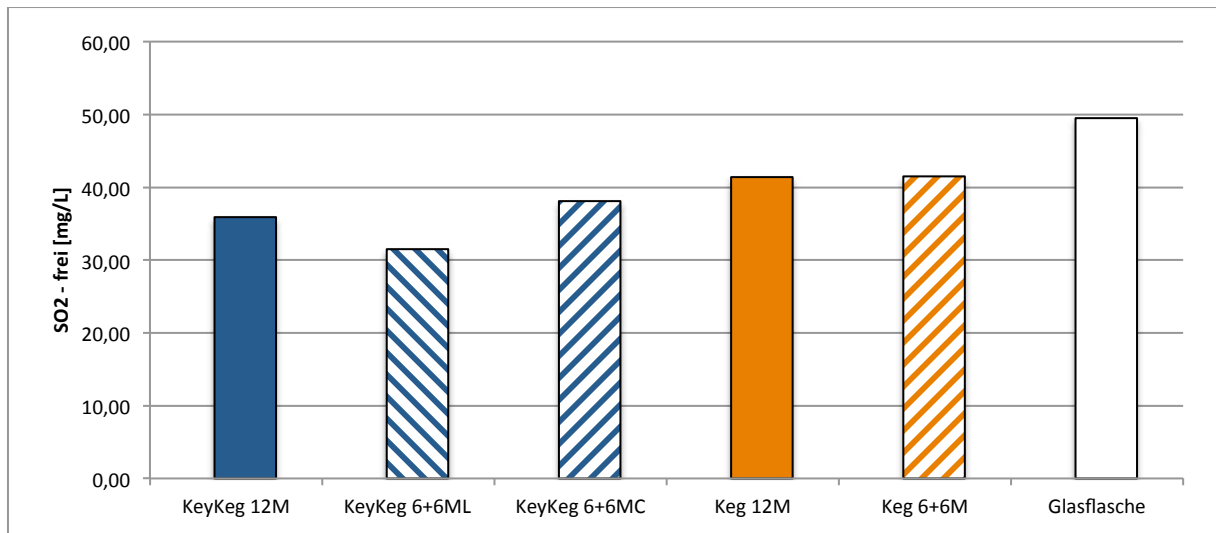


Abb.7: Sparkling wine, free SO<sub>2</sub>, 15°C

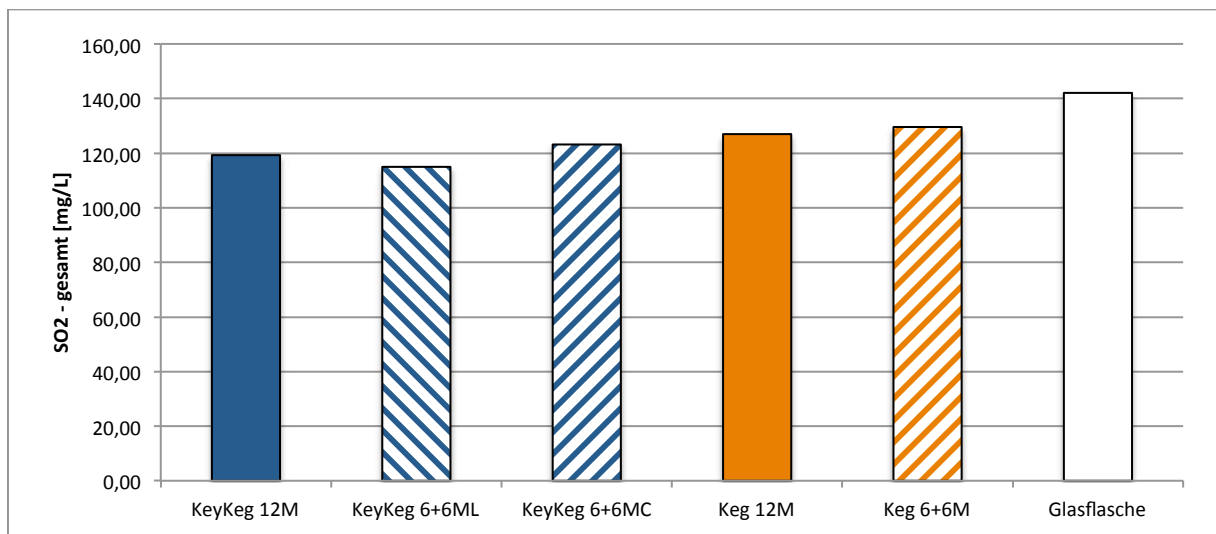


Abb.8: Sparkling wine, total SO<sub>2</sub>, 15°C

## 5 Comparative sensory testing of the samples

Sensory analysis was done at the Geisenheim research Center with a trained panel for wine tasting. For the tasting after 12 months different samples from *storage* at 15°C were selected for the panel.

The sensory tests took place in June, 14<sup>th</sup> and 15<sup>th</sup>, 2012 with panels of **14** resp. **16** trained testers. For the analysis of differences between the bottles with different types of seals or treatments, 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 criterion.

### 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 criterion 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 an 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%.

In the actual session, the following ranking tests were carried out.

### Still wine

	Product 1	Product 2	Product 3
<b>Ranking 1</b>	KeyKeg 12 Months	Bag in Box 12 Months	Glas 12 Months
<b>Ranking 2</b>	KeyKeg 6+6 Months air	KeyKeg 6+6 Months CO <sub>2</sub>	KeyKeg 12 Months
<b>Ranking 3</b>	KeyKeg 6+6 Months air	Bag in Box 6+6 Months	Bag in Box 12 Months

### Sparkling wine

	Product 1	Product 2	Product 3
<b>Ranking 4</b>	KeyKeg 12 Monate	Keg 12 Months	Glas 12 Months
<b>Ranking 5</b>	KeyKeg 6+6 Months air	KeyKeg 6+6 Months CO <sub>2</sub>	KeyKeg 12 Months
<b>Ranking 6</b>	KeyKeg 6+6 Months air	Keg 6+6 Months	Keg 12 Months

### Ranking Test Results **Still wine**:

After 12 months of storage **significant differences** could be detected for the rankings with still wines in different packaging. In comparison the wines in glass bottles and KeyKegs were judged to be fresher and fruitier than those in Bag-in-Box. No significant differences were found for wines which came from KeyKegs “fresh opened” after 12 months of storage compared to those wines coming out of KeyKegs which had already been opened once after 6 months of storage. Those wines from KeyKegs being opened after 6 months, already were even judged to be tending fresher than wines coming out of Bag-in-Boxes being freshly opened after 12 months of storage.

### Ranking Test Results **Sparkling wine**:

After 12 months of storage **no significant differences** could be detected for the rankings with sparkling wines in different containers. Also for the comparison of freshly opened and for 6 months in opened situation stored containers no sensory difference could be detected significantly. No influence of using different gases (air, CO<sub>2</sub>) was significant for the sensory comparison after 12 and 6 +6 months of storage.

## Triangle Test

In the triangle test the judges have to find the difference between two different samples. One of those samples is given in duplicate to the judges the other sample single. The task for the panellist is, to find out the different sample.

All samples were given randomised and coded to the judges. The sample preparation and calculation of the test results were done with the sensory-software "FIZZ".

For the sensory triangle tests after 12 months of storage the following triangles were given to the panellists:

	<b>Wine / storage</b>	<b>Produkt 1</b>	<b>Produkt 2</b>
Triangle 1	<b>Still wine,</b> <b>15°C storage</b>	KeyKeg 12 Months	Glas 12 Months
Triangle 2	<b>Still wine,</b> <b>15°C storage</b>	KeyKeg 12 Months	Bag in Box 12 Months
Triangle 3	<b>Still wine,</b> <b>15°C storage</b>	KeyKeg 12 Months	KeyKeg 6+6 Months air
Triangle 4	<b>Still wine,</b> <b>15°C storage</b>	KeyKeg 12 Months	KeyKeg 6+6 Months CO <sub>2</sub>
Triangle 5	<b>Still wine,</b> <b>15°C storage</b>	KeyKeg 6+6 Months air	Bag in Box 12 Months
Triangle 6	Sparkling wine, <b>15°C storage</b>	KeyKeg 12 Months	Glas 12 Months
Triangle 7	Sparkling wine, <b>15°C storage</b>	KeyKeg 12 Months	Keg 12 Months
Triangle 8	Sparkling wine, <b>15°C storage</b>	KeyKeg 12 Monate	KeyKeg 6+6 Months air
Triangle 9	Sparkling wine, <b>15°C storage</b>	KeyKeg 12 Months	KeyKeg 6+6 Months CO <sub>2</sub>
Triangle 10	Sparkling wine, <b>15°C storage</b>	KeyKeg 6+6 Months air	Keg 6+6 Months

In the 10 triangle tests only in three comparisons significant difference between the samples could be detected.

In one case (triangle No. 2) KeyKeg could be differentiated from Bag-in-Box and the judges preferred the wines in KeyKeg.

In triangles No. 5 and 7 the panelists could find differences between the wines stored in KeyKeg (6+6 air) and Bag-in-Box (fresh) (triangle 5) and between KeyKeg and Keg (sparkling wine, triangle 7). In both cases the judges found sensory differences but no preference was given.

Summarizing also in the triangle tests and rankings the analytical results could be confirmed after a storage time up to 12 months. It is obvious that KeyKeg Containers can be used for wine storage for this period, even under the situation that the containers are open for a longer time. No significant effect could further be found by using different gases for tapping the containers.