Filtered vs. Cloudy Olive Oil

VSEP membrane filtration study of Extra Virgin Olive Oil (EVOO)

Background

After the conventional method of processing olive oil using decanter centrifuges, the oil will appear cloudy and will contain some amounts of suspended solids, microbes that decompose the olive flesh, free fatty acids, water, and other large materials. While these things can contribute to the robustness of the oil and contribute to a "musty" flavor, these things can also affect the shelf life of the oil.

Filtration of olive oil would mean an extra handling step and ideally, the oil should be handled as little as possible prior to bottling to prevent oxidation of the oil. But if done with a nitrogen purge or a minimum amount of handling, filtration could add benefits to the product by removing materials that can shorten the shelf life.

However, it is necessary that the filtration does not affect the sensory characteristics of the oil and that the healthy nutrients, vitamins, and anti-oxidant polyphenols are not removed. These are the things that make olive oil distinctly healthy and enjoyable.

Various types of filtration have been used. These include the use of filter aides such as diatomaceous earth and cellulose fibers. Conventional crossflow polymeric membranes (spiral membranes) have also been used, but this method has not been widely adopted due to the fact that the fluid mechanics of olive oil are not ideal for this type of system. In addition, polypropylene bag filters have been used.

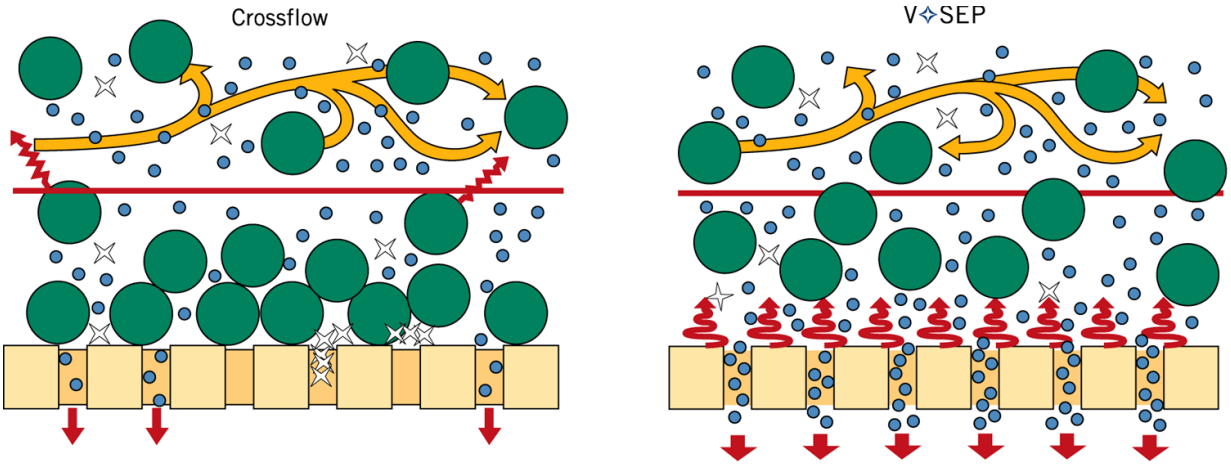
Bag filters and filter aides provide some amount of filtration, although, it is very coarse filtration. The benefit of membrane filtration is that very precise pore size selection can allow for very precise cut offs that allow some things to pass and others to be rejected. Membranes are also capable of virtually 100% removal of suspended solid particles.

Excess sediment is not beneficial for olive oil and the amount of sediment can affect the shelf life. Olive oil that will be stored before bottling is typically "racked", or, separated from sediment and humidity. Unfiltered olive oil will be cloudy and will have some sediment and humidity, but, it is best to minimize the amount of sediment and water. In storage tanks, the sediment and water will settle to the bottom and one method of racking is to purge this material from the bottom of the tank to remove it from the oil. However, settling can only occur for fairly large size particles. Small micron sized particles will not settle or may take months to settle.

New Logic recently conducted a study to look at the use of polymeric membranes in its vibratory VSEP membrane filtration system to filter olive oil without compromising the healthy aspects of the oil or the pleasure and sensory characteristics of the oil. New Logic tested several membrane type with varying pore sizes and polymer types to measure the relative performance.

VSEP Treatment Process

VSEP (Vibratory Shear Enhanced Process) employs torsional vibration of the membrane surface, which creates high shear energy at the surface of the membrane. The result is that colloidal fouling and polarization of the membrane due to concentration of rejected materials are greatly reduced. Since colloidal fouling is avoided due to the vibration, VSEP can handle viscous materials and feed liquids with very high solids concentrations. In addition, the throughput rates of VSEP are 5-15 times higher in terms of GFD (gallons per square foot per day) when compared to other types of membrane systems. The sinusoidal shear waves propagating from the membrane surface act to hold suspended particles above the membrane surface allowing free transport of the liquid media through the membrane.



Fluid Dynamics Comparison between VSEP and Conventional Crossflow Filtration

VSEP Test Results

For this test, Extra Virgin Olive Oil (EVOO) was provided by Corto Olive Oil of California during the 2013 harvest season. The oil was processed from mono-varietal Arbequina Olives. At the completion of testing three samples including racked, unracked, and VSEP filtered EVOO were collected in clear glass bottles and stored in darkness at 18ºC and tested every month.

During the initial part of testing, several Teflon membranes were chosen for study. Teflon is a hydrophobic material that readily accepts oil wetting and repels water. Other polymeric membranes are hydrophilic and will accept water, but reject oil. So these were deemed to be not suitable for this application. The test was done on four different Teflon membrane with pore sizes ranging from 0.05 to 5.0 microns. The following table shows the relative permeability rate (flux rate) of each:

Membrane	Test Apparatus Flow Rate	Flux Rate[1]
0.05 µm Teflon	2.8 ml/min	2.1 GFD
0.1 µm Teflon	21 ml/min	16 GFD
1.5 µm Teflon	13 ml/min	10 GFD
5.0 µm Teflon	840 ml/min	638 GFD

1. GFD = Gallons per square foot per day

All of these membrane produced a filtrate with turbidity and cloudiness removed without any change to the color of the oil. The 0.1µm Teflon was chosen for further study since it had a relatively tight pore size and a reasonable flux rate. A sample of the filtered EVOO was taken while using this membrane.

During storage of the oil, several measurements were taken. Free Fatty Acids (FFA) contribute to oxidation of the olive oil. The oxidation rate of the oil can affect the shelf life. Suspended solids from the olive fruit can encourage hydrolysis and rancidity in the oil during storage and so removal of this sediment can also improve shelf life.

The concentration of FFA in the filtered oil was 14% lower than the racked or unracked olive oil.

The Peroxide Value (PV) of the oil was also measure. This indicates the amount of oxidation that occurred due to handling of the oil during processing. The filtered oil did present a higher PV value in terms of mEq O2 measured than either of the unfiltered oils. This would be due to the open tank storage and mixing of the oil during filtration. This process can be done under an Argon or Nitrogen purge to prevent this oxidation.

The results show that with the removal is sediment and some of the Free Fatty Acids, the shelf life should be improved for the EVOO.

While the taste of filtered oil may vary depending on the variety of olive fruit, a taste test was conducted at UC Davis and it was determined by a panel of taste testers that the filtered oil had greater freshness, complexity, and flavor intensity with no change in bitterness, astringency, or pungency.

One other noticeable difference was the texture of the oil. The filtered EVOO was leaner while the unfiltered oil was thicker. Texture does count as part of the taste experience with olive oil

Summary

As with anything, different people will have different preferences. But the results of this work show that there were minimal changes to the color and taste experience of the oil. In addition, the removal of sediment, humidity, and some of the Free Fatty Acids can result in extended shelf life of the product. This can have significant commercial benefits.

For more information about a VSEP system, contact your New Logic sales engineer

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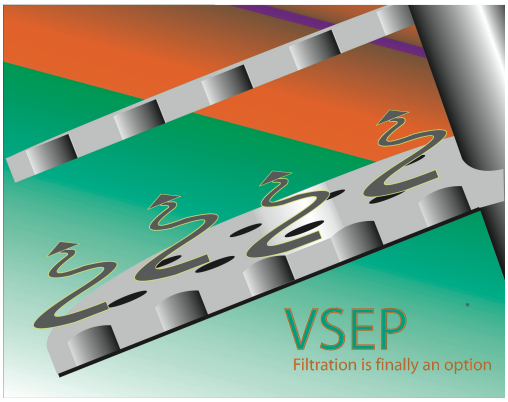

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