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Application Note

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Ergonomic and Efficient Filtration for Food Analytics

Preparation of particle-containing and viscous food samples with the Claristep® filtration system

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Abstract

In food analytics, clarification by membrane filtration is often an important step in sample preparation for processes like HPLC. Designed for parallel processing of up to eight samples, the Claristep® filtration system was examined to determine its suitability for the filtration of food samples. Fourteen commercially available food samples – among them very particle-rich dispersions – were filtered at various levels of dilution with the syringeless Claristep® 0.45 µm and 0.2 µm pore size filters and the manual Claristep® base. Suitable dilutions were also tested with an established syringe filtration system, and the two techniques were compared with regard to ease and comfort of use. The results show which levels of dilution can be expected to result in successful filtration. In comparison to conventional filtration systems, testers consistently reported better ergonomic handling and significant time savings in sample preparation with Claristep®.

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Introduction

In food production – and not only at the industrial scale – a variety of substances are used to influence properties like nutrient content, taste, and shelf life. These include additives like food coloring and preservatives, as well as compounds present as impurities in the raw materials, such as pesticides and antibiotics. Because these may reduce the quality of the foods or even damage health, analytical tests are indispensable and often required by lawmakers.

In the preparation of food samples, filtration of liquid, sometimes disperse or viscous food samples is an unavoidable step before nearly all techniques used in food analytics, such as high pressure liquid chromatography (HPLC). In order to reliably protect instruments from the introduction of particles and maintain the performance of analytical systems, high standards are demanded of any filtration method used.

Food samples like fruit juice, ketchup, or salad dressings are often highly viscous with a high density of particles. Clarification by filtration often requires use of extreme force, which can lead to physical pain in the user. Some samples must therefore be highly diluted for clarification, which can make it difficult to reach a satisfactory detection limit in subsequent analysis.

The Claristep® system (see Figure 1) is a new, multiplexing filtration process that combines high sample throughput with low physical strain. The manual system consists of a base with eight individual syringeless filter units designed for sample volumes of 60 µL to 600 µL. The samples are filtered directly into conventional standard 2 mL HPLC vials, making them ready for immediate analysis.

The following demonstrates the applicability of the Claristep® system through clarification of fourteen food samples that are difficult to filter. The comfort of users is also compared with conventional syringe filtration methods.

Procedure

Determination of the target concentration
Fourteen different food samples were tested (see Table 1). In order to determine the concentration at which manual clarification can be carried out by filtration with no problems, the food samples were diluted with water in seven steps (100 = undiluted, 75, 50, 25, 10, 5, 2, and 1 % solutions). A sample was considered filterable if it could be completely filtered with a reasonable amount of exertion. The person carrying out the filtration carried this step out while standing comfortably and using both hands. The properties of the filtration, the yield, and the subjective assessment of the user were all evaluated.

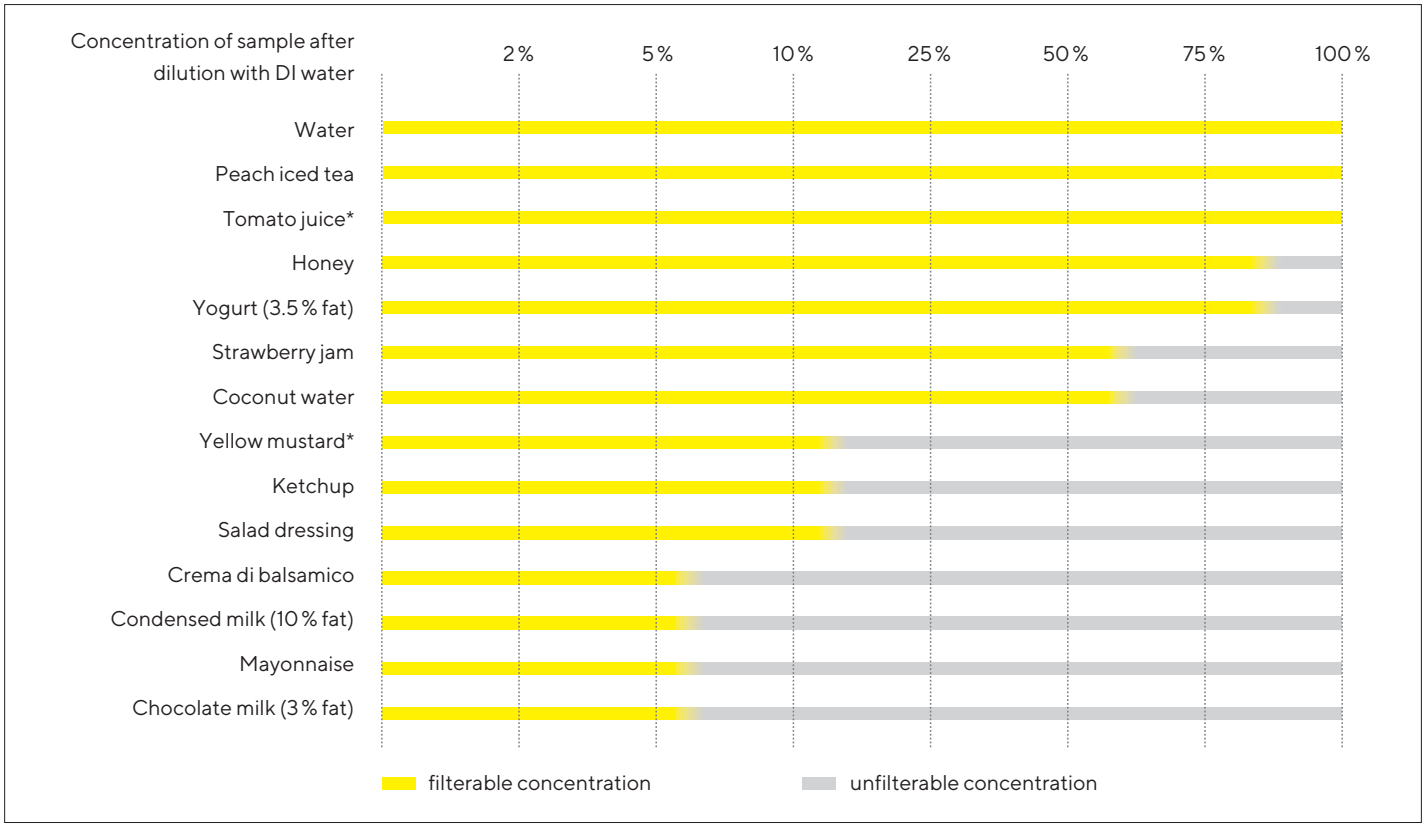
With the Claristep® filtration system, eight different dilutions of a food sample were filtered at once. The sample volume was 400 µL. Both the Claristep® 0.2 µm and 0.45 µm filters were used.

Subjective determination of user comfort
To compare the user comfort between the Claristep® filtration system and syringe filters, the samples were additionally filtered with a syringe filter (RC; 0.45 µm pore size; 25 mm filter diameter). Achievement of a filtration volume between 0.5 and 1 mL was required.

Measurement of viscosity
The viscosity of the least filterable diluted samples was determined with the Haake ViscoTester VT5L.

Figure 1: Claristep® filter and Claristep® base

Table 1: Claristep® 0.2 µm and 0.45 µm: clarification filtration of difficult food samples at various levels of dilution. For every trial, one undiluted sample (100 %) was filtered at the same time as seven different dilutions, each with a sample volume of 400 µL. Represented are the filterability of the different food samples at different levels of dilution (results for 1 % solutions are not shown).



* The filterability of the samples was generally not measurably influenced by the pore size. Exceptions were samples of tomato juice and mustard, which required more dilution for filtration at 0.2 µm than at 0.45 µm (tomato juice 75 %, yellow mustard 2 %).

Results

In principle, filtration of all 14 of the food samples tested is possible with all three filters. Some of the samples had to be extensively diluted to be filterable (Table 1). As expected, it is possible to filter samples with the same or higher concentrations when using the 0.45 µm pore size as with the 0.2 µm pore size. The yields obtained for the least dilute solutions that could be filtered with the Claristep® 0.45 µm were comparable to those obtained with the 0.45 µm syringe filter.

With the Claristep® filtration system it was also possible to easily and reliably filter undiluted, highly viscous food samples like tomato juice (Tables 1 and 2). Other food samples that are difficult to filter, such as yogurt or honey required only a slight amount of dilution to be processed by the Claristep® filtration units. Whereas some samples could only be pressed through a syringe filter with a noticeably large amount of exertion, filtration with Claristep® gave comparable yields without a large expenditure of effort. The users consistently reported that their work was considerably easier and that they saved a significant amount of time when using the Claristep® system.

Table 2: Viscosity measurements of the target concentrations. Measurements were made at the concentration that could just still be filtered with the Claristep® base and the Claristep® 0.45 µm and 0.2 µm filter units (target concentrations).

Sample	Viscosity [mPas]
Water	1
10 % Yellow mustard*	6
100 % Peach iced tea	2
10 % Ketchup	8
100 % Tomato juice*	15704
10 % Salad dressing	6
75 % Honey	42
5 % Crema di balsamico	8
75 % Yogurt (3.5 % fat)	10792
5 % Condensed milk (10 % fat)	5
50 % Strawberry jam	17
5 % Mayonnaise	5
50 % Coconut water	8
5 % Chocolate milk (3 % fat)	5

Discussion

Food analytics presents a major challenge for efficient and reliable clarification filtration systems. The filtration step is necessary before chromatographic analysis and other tests |in order to guarantee the quality of measurements and to protect sensitive instruments. This step in the laboratory routine is labor intensive, can be physically demanding for laboratory staff at high sample frequencies, and has a large influence on the efficiency of the laboratory.

In principle, all three of the filter types tested are suitable for preparing food samples for subsequent analysis. We have demonstrated that the Claristep® makes it possible to quickly and reliably process eight samples simultaneously. In comparison to syringe filtration systems, the Claristep® system consistently filters samples of comparable concentration with sometimes significantly less physical exertion. This avoids additional dilution of the sample, which may not allow satisfactory detection limits to be attained.

Particle-rich or highly viscous suspensions like those frequently found in food analytics particularly demand a rapid and robust standard method for sample preparation. With this report, we have demonstrated that the Claristep® filtration system is an efficient and ergonomic alternative to current sample preparation methods that use syringe filters. This method works without the complex apparatus involved in vacuum or pressure filtration, and facilitates efficient laboratory operation, even at high sample throughput.

Conclusion

Especially when there are large numbers of samples to be processed, the Claristep® filtration system saves the user time, effort, and materials. Multiplexing allows for the filtration of eight samples in a single step. Samples that are difficult to filter or have a small volume can be reliably processed. In addition, use of the Claristep® base prevents the hand strain that typically occurs with repetitive motion sequences.

References

- Food Analysis by HPLC, Edited by Leo M.L. Nollet, Fidel Toldra, Third Edition CRC Press, 16.11.2012
- Instruction manual for Claristep®: Publication No.: SL-6207-p

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