EC Nutrition Researcher's Column - 2016

Asymmetrical Flow Field-Flow Fractionation for the Analysis of Egg Yolk Plasma

"Asymmetrical flow field-flow fractionation coupled with UV/VIS detector provided not only the separation of major components of the egg yolk plasma i.e. soluble proteins, low density lipoproteins (LDL), and their aggregates, but also the size distribution of major components"

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RESEARCHER'S COLUMN ARTICLE

Hen eggs are inexpensive and low calorie source of nutrients such as Vitamin D. Furthermore, hen egg is a source of high quality protein, and the lipid matrix of the yolk serves to enhance the bioavailability of nutrients such as lutein [1]. Hen egg yolk consists of soluble plasma that is composed of ~15% livetins and ~85% low density lipoprotein (LDL), and non-soluble granules. Compared to other animal protein sources, egg yolk contains proportionately less saturated fat, which has generally been recognized as a strong dietary determinant of elevated LDL levels and increased risk of coronary heart disease. In addition to nutritional value, egg yolk plasma components also play an important role in the textural properties of final food products and the functionality may be further complicated to predict in the presence of other food ingredients [2]. The detailed characterization of egg yolk plasma is needed for better understanding of functionality of egg yolk components.

Asymmetrical flow field-flow fractionation (AF4), a tool for the separation and characterization of bio samples, has attracted increasing interest in recent years owing to its broad dynamic range (approximately from 1 nm up to about 100 μm) and the utilization of an "open channel" void of stationary phase or packing materials [3]. The absence of a stationary phase makes AF4 a gentle fractionation technique with no or limited shear and mechanical stress applied on sample components, particularly suited for the analysis of delicate analytes with full preservation of their native properties.

In this work, hen egg yolks were pooled and gently mixed at 4^0C. 4 mL pooled egg yolk was diluted with an equal volume of 0.17 M NaCl solution and stirred with a magnetic stirrer for 1 h at 4^0C. The sample was then centrifuged at 10000g for 30 min at 4^0C, and the supernatant (plasma) was separated from the sediment (granules). The egg yolk plasma solution was further diluted (5:95 v/v) with the carrier liquid prior to injection into AF4 channel. The carrier liquid was water containing 10 mM imidazole and 170 mM NaCl. Figure 1a shows AF4-UV/VIS fractogram and hydrodynamic radius of components of egg yolk plasma. The result shows that the hydrodynamic radius of major components of egg yolk plasma ranges from a few nano-

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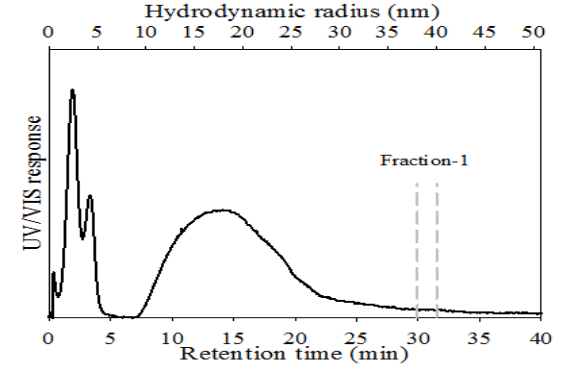
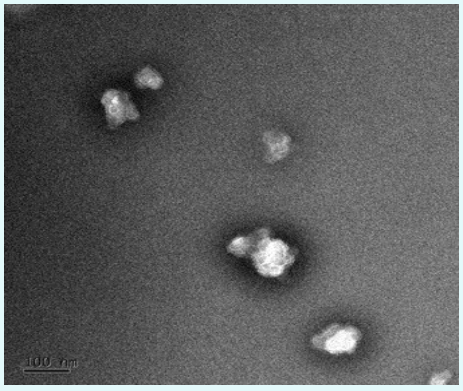
meters to about 50 nm. The first population eluted before 5 min most likely contains the livetins. The second population peaking at 14 min most likely contains LDL. It was also found that the second population followed by a tail which is due to LDL aggregates as indicated by the Bio-TEM image. The results reveal that livetins, LDL, and LDL aggregates can be separated by AF4 in a single run. The method proposed in this work may open the interesting opportunity to study the relationship between aggregates in egg yolk plasma and their nutrition.



(a)



(b)

Figure 1: AF4-UV/VIS fractogram and hydrodynamic radius of major components of egg yolk plasma;

Figure 1a: A representative Bio-TEM image of fraction-1.

Figure 1b: Operation conditions: cross flow=2.0 mL/min, channel flow=1.0 mL/min, and the carrier liquid was water containing 10 mM imidazole and 170 mM NaCl.

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Conflict of Interest

All authors declare that they have no conflict of interest.

Bibliography

1. KL Herron and Fernandez ML. "Are the Current Dietary Guidelines Regarding Egg Consumption Appropriate?" *The Journal of Nutrition* 134. (2004): 187-190.

2. E. Magnusson and Lars Nilson. "Interactions between hydrophobically modified starch and egg yolk proteins in solution and emulsions". *Food Hydrocolloids* 25.4 (2011): 764-772.

3. H. Dou, *et al.* "Study on antidiabetic activity of wheat and barley starch using asymmetrical flow field-flow fractionation coupled with multi angle light scattering". *Journal of Chromatography A* 1340 (2014): 115-120.