Eggs contain NanoVehicles; NanoPrime Labs offers Egg-free NanoVehicles

Dr. Petro P. Czupiel, PhD

Abstract

NanoVehicles are nanostructured vehicles with dimensions spanning from 1 nanometer to 15,000 nanometers. Interestingly, eggs contain two such NanoVehicles. By breaking down eggs into their components, we find that egg yolk consists of two NanoVehicles: egg NanoVehicle 1 (low-density lipoprotein (LDL) micelles) and egg NanoVehicle 2 (egg granules). These NanoVehicles have distinct diameter ranges, with egg NanoVehicle 1 measuring 17-60 nanometers and egg NanoVehicle 2 measuring 300-2,000 nanometers. Both are complex vehicles designed to carry the vitamins and protein found in egg yolk. Comparing egg NanoVehicles to milk NanoVehicles reveals both similarities and differences. Moreover, egg NanoVehicles are distinct from other egg-free NanoVehicles like nanoemulsions, microemulsions, and micelles. The potential impact of egg-free NanoVehicles on dietary supplements is significant, as they can enhance the delivery of oil-loving natural health ingredients into the bloodstream. NanoPrime Labs possesses the technology to incorporate oil-loving natural health ingredients into egg-free NanoVehicles, promoting consumers' wellness and health.

1. Introduction

Eggs are a ubiquitous food staple, prized for their high nutritional value, versatility, and ease of use in various sweet and savory dishes.[1] With a calorie count of 70-90 per egg, they offer a rich source of vitamins, protein, and essential nutrients. Egg yolks, in particular, are packed with oil-loving ingredients like cholesterol, mono- and polyunsaturated fats, as well as lutein and zeaxanthin, which have been shown to reduce the risk of eye diseases like macular degeneration and cataracts.[2,3] The bodybuilding industry has long recognized the importance of eggs as a powerful source of protein, with each egg providing approximately 6.3 grams of protein. Celebrities like Arnold Schwarzenegger have also endorsed eggs for their high protein content.[4] From breakfast staples to dessert ingredients, egg yolks prove to be an incredibly valuable and versatile food.

In our previous white papers, we explored the differences between water-loving and oil-loving ingredients, providing examples to aid identification. We also discussed how milk contains two types of NanoVehicles, defined as nanostructured vehicles with dimensions ranging from 1 nanometer to 15,000 nanometers. To put this into perspective, if a marble represents one nanometer, the Earth would be equivalent to one meter. Eggs, however, present a complex identification challenge due to their multiple components. This white paper aims to clarify this issue and determine whether eggs are primarily oil-loving or water-loving ingredients.

2. Eggs contain a combination of NanoVehicles

When you crack open an egg, you're greeted by two distinct components: the egg white and the egg yolk. The average egg weighs around 60 grams, comprising 59% egg white, 31% egg yolk, and 10% eggshell. The edible portions, egg white and egg yolk, are further broken down into 74.4% water, 14.0% protein, and 11.6% lipids.[5] Eggs are a rich source of essential vitamins, excluding vitamin C.[6] For this discussion, we'll focus on the egg yolk, also known as vitellus, which is a nutrient-rich, viscous portion of the egg.[7] Egg yolks primarily supply food and promote embryo development, comprising 65% lipids, including triglycerides, phospholipids,

cholesterol, and carotenoids, which give them their yellow-orange hue.

Egg yolks are a complex system naturally containing various NanoVehicles. **Figures 1** and **2** reveal the intricate structure of egg yolks. At 10,000x magnification, two egg NanoVehicles become apparent: smaller, yellow LDL micelles and larger egg granules composed of LDL micelles, HDL micelles, and phosvitin. Due to their size difference, these NanoVehicles can be purified and separated through centrifugation at 10,000 G-force.[8] This process has significant implications, including providing soy-free ingredients for consumers with allergies and potential applications in food, cosmetics, and biotechnology. Interestingly, the NanoVehicle power in eggs has been utilized in manufacturing salad dressings and mayonnaise, which are emulsions.[9] In the next section, we'll delve deeper into the complexity of these two egg yolk NanoVehicles.

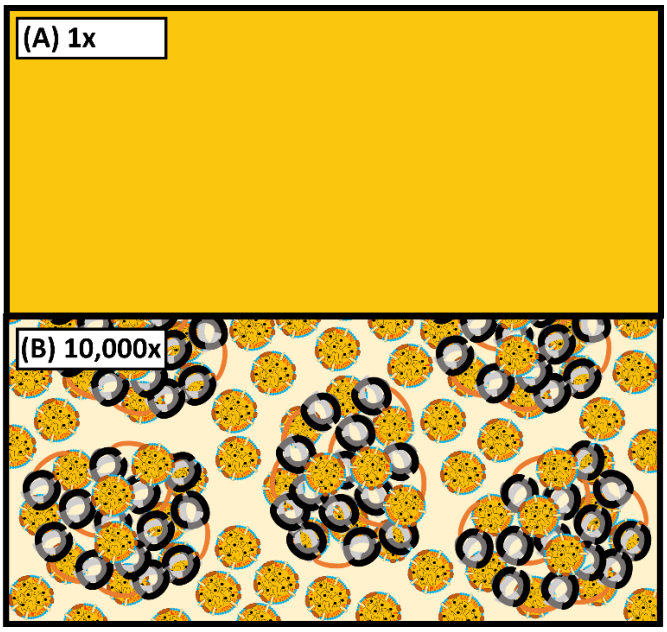

Figure 1. Schematic diagram of egg yolk with (A) no magnification or 1x zoom, and (B) 10,000x magnified zoom of egg yolk. The 1x zoom of egg yolk is what we see when we crack eggs for cooking. The 10,000x magnified zoom of egg yolk presents the two types of NanoVehicles that are present in egg yolk. The smaller yellow NanoVehicles represent egg yolk micelles, while the larger NanoVehicles represent the egg granules.

3. Egg NanoVehicle 1: Egg Yolk Micelles

Egg yolks are not simply a pure protein solution, but a complex dispersion of multiple NanoVehicles. Among these, the smaller egg NanoVehicle, known as egg yolk micelles, makes up 85% of the egg yolk plasma, with the remaining 15% comprising livetin, a type of water-loving globular protein.[7] Egg NanoVehicle 1, or egg yolk micelles, are composed of lipids and proteins that naturally form in egg

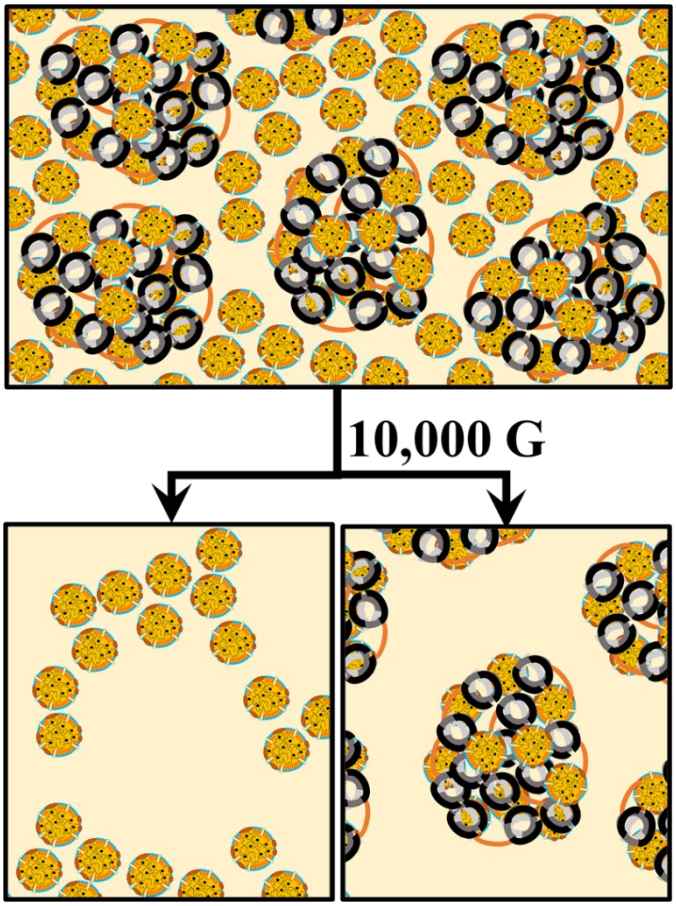

Figure 2. Schematic diagram representing how the two types of egg yolk NanoVehicles can be purified. Specifically, low-density lipoprotein (LDL) micelles can be purified from the egg granules by using centrifugation at 10,000 G-force (G).

yolks, with a neutral interior consisting of triglycerides and cholesterol esters surrounded by apoproteins and phospholipids. Six apoproteins have been identified, integrating into the egg NanoVehicle 1, which ranges in diameter from 17 to 60 nanometers.[5]

The egg NanoVehicle 1, or egg yolk micelles, bears similarities to milk NanoVehicle 1, or milk casein micelles, with both having diameters under 300 nm. However, egg NanoVehicle 1 is more complex, comprising apoLDL, cholesterol, cholesterol esters, triglycerides, and phospholipids, whereas milk NanoVehicle 1 consists of casein submicelles, calcium phosphate nanoclusters, and protein chains. This complexity may explain why egg yolks are more extensively used in the food and cosmetic industries, providing more nutrition and protein compared to milk. The egg NanoVehicle 1 is smaller in diameter, ranging from 17 to 60 nanometers, compared to milk NanoVehicle 1, which ranges from 154 to 230 nanometers.

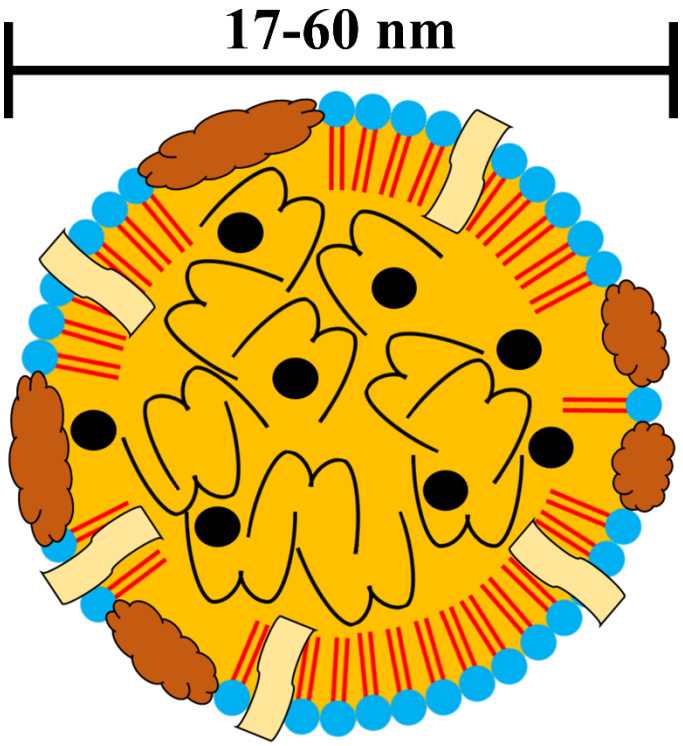

Figure 3. Schematic diagram representing the complexity of one of the NanoVehicles found in egg yolk, otherwise known as low-density lipoprotein (LDL) micelles. The diameters of the egg yolk micelles range from 17 to 60 nanometers (nm). The egg yolk micelles are composed of apolipoproteins of low-density lipoproteins (apoLDL) represented as , cholesterol represented as , cholesterol esters represented as , triglycerides represented as , and phospholipids represented as .

4. Egg NanoVehicle 2: Egg Yolk Granules

This section delves into the larger NanoVehicle found in egg yolk, known as egg yolk granules or egg NanoVehicle 2. As shown in **Figure 1**, egg

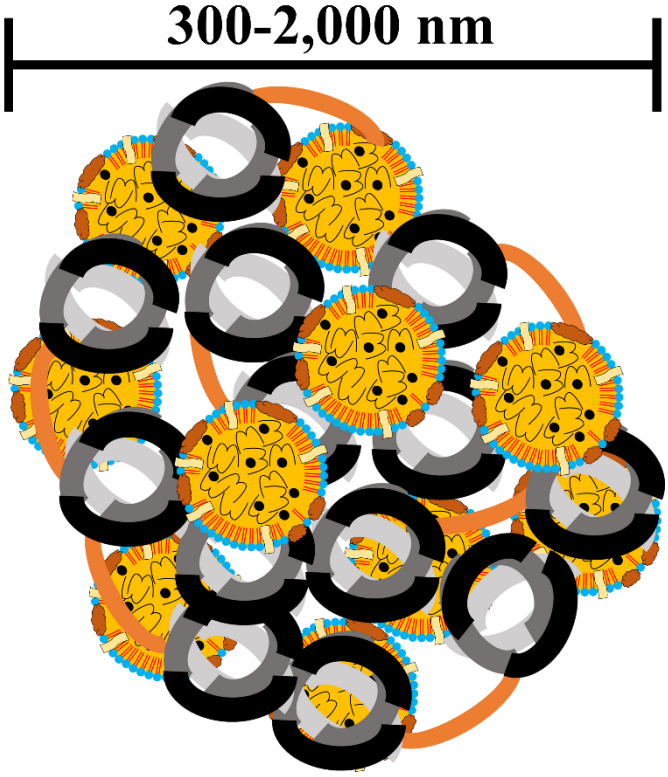

Figure 4. Schematic diagram representing the other type of NanoVehicles found in egg yolk, otherwise known as egg granules. Specifically, the egg granules are a combination of low-density lipoprotein (LDL) micelles represented as yellow circles, high-density lipoprotein (HDL) micelles represented as black and gray circles, and phosvitin integrating into the LDL and HDL micelles represented as an orange shape. The diameters of these egg yolk NanoVehicles ranges from 300 to 2,000 nanometers (nm).

NanoVehicle 2 has a larger diameter than egg NanoVehicle 1 and is more complex in composition. Despite making up only 22% of yolk matter, egg yolk granules carry 50% of yolk proteins and 7% of yolk lipids, making them a crucial component for bodybuilders and health-conscious consumers seeking egg protein. **Figure 4** illustrates the schematic diagram of egg NanoVehicle 2, which ranges in diameter from 300 to 2,000 nanometers and consists of 70% HDL micelles, 14% egg LDL micelles, and 16% phosvitin, a highly phosphorylated protein.

In comparison to egg NanoVehicle 1, egg NanoVehicle 2 is more complex and larger in

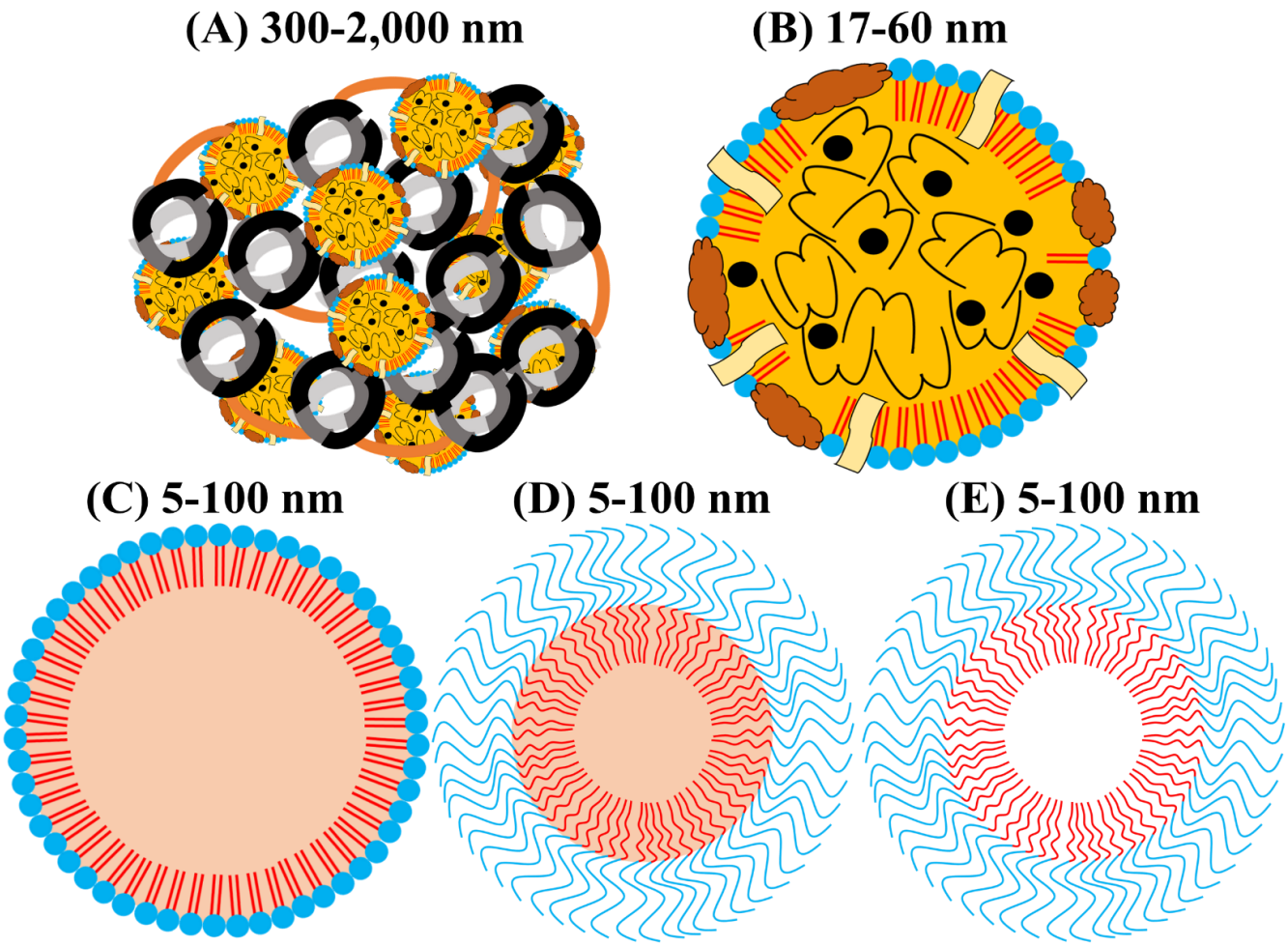

Figure 5. Diagrams representing the sizes and structures of different NanoVehicles including (A) egg yolk granules, (B) egg low-density lipoprotein (LDL) micelles, (C) nanoemulsions, (D) microemulsions and (E) micelles. (A) The large egg yolk NanoVehicles, otherwise known as egg yolk granules, have diameters ranging from 300-2,000 nanometers which include a combination of LDL micelles, high-density lipoprotein (HDL) sub-micelles, and phosvitin. (B) The smaller egg yolk NanoVehicles, otherwise known as LDL micelles, have diameters ranging from 17-60 nanometers. (C) Nanoemulsions consist of an oil core that is surrounded with amphiphilic emulsifiers. These emulsifiers contain an oil-loving component that incorporates into the oil-core, and a water-loving component that interacts with water. (D) Microemulsions also consist of an oil core that is surrounded with amphiphilic emulsifiers. (E) Micelles are similar to microemulsions except that the oil core is missing. Nanoemulsions, microemuslions and micelles have diameters that range from 5-100 nanometers.

diameter. Interestingly, the various NanoVehicles within egg NanoVehicle 2 can be further processed under different conditions of salt, pH, and temperature. When compared to raw milk NanoVehicle 2, egg NanoVehicle 2 has a smaller diameter range (300-2,000 nanometers vs. 1,000-15,000 nanometers) and different composition. While both naturally occur in opaque solutions, the processed milk NanoVehicle 2 has similar diameters to egg NanoVehicle 2 but distinct compositions. The egg granules' smaller diameter range may be due to their complex structures, which differ from the three-layered lipid membrane of milk fat globules. Again, it's clear that egg NanoVehicle 2 is more complex and smaller in diameter compared to milk NanoVehicle 2.

5. Other types of NanoVehicles

Egg yolks contain NanoVehicles like LDL micelles and egg yolk granules, which differ from nanoemulsions, microemulsions, and micelles. Emulsions, nanoemulsions, and microemulsions combine two unmixable liquids, but their physical properties vary. Micelles are similar to microemulsions but lack the oil component. **Figure 5** compares the sizes of these NanoVehicles, showing that egg NanoVehicles have larger diameters (17-2,000 nanometers) than nanoemulsions, microemulsions, and micelles (less than 100 nanometers).

Nanoemulsions, microemulsions, and micelles have smaller diameters, allowing light to pass through their solutions, resulting in translucent or transparent solutions. These NanoVehicles are simpler and more bioengineered than egg NanoVehicles. Nanoemulsions, used in pharmaceuticals, have an oil core stabilized by amphiphilic emulsifiers, which facilitate delivery of therapeutics or natural health ingredients. Microemulsions and micelles are similar, with potential applications in dietary supplements.

Nanoemulsions are used in cancer therapeutics and COVID-19 vaccinations, acting as delivery vehicles for oil-loving ingredients like docetaxel and mRNA.[10] Microemulsions and micelles are suitable for dietary supplements, with potential benefits for enhanced delivery into the blood. Micelles have been used in pharmaceuticals to improve delivery of active pharmaceutical ingredients, and their egg-free nature makes them suitable for dietary supplements.

All egg-free NanoVehicles, except nanoemulsions, form naturally in the stomach and require amphiphilic emulsifiers with longer water-loving components. This component aids in delivery, absorption, and trafficking of ingredients through the blood, maximizing bioavailability and benefits. These egg-free NanoVehicles are efficient for oil-loving therapeutics or natural health ingredients, with the water-loving component playing a pivotal role. In summary, egg NanoVehicles differ from nanoemulsions, microemulsions, and micelles in terms of size and complexity. Egg-free NanoVehicles are simpler, bioengineered, and suitable for dietary supplements, with potential benefits for enhanced delivery into the blood. The water-loving component of amphiphilic emulsifiers is crucial for maximizing bioavailability and benefits.

6. Conclusion

NanoVehicles, defined as nanostructured vehicles with dimensions spanning 1-15,000 nanometers, are found in eggs, comprising multiple NanoVehicles. Egg yolk, in particular, contains two distinct NanoVehicles: egg NanoVehicle 1 (LDL micelles) with diameters ranging from 17-60 nanometers, and egg NanoVehicle 2 (egg granules) with diameters ranging from 300-2,000 nanometers. Both NanoVehicles play a crucial role in delivering vitamins and protein found in egg yolk. Comparisons were made between egg NanoVehicles and milk NanoVehicles, as well as egg-free NanoVehicles like nanoemulsions, microemulsions, and micelles. Notably, egg-free NanoVehicles have the potential to revolutionize dietary supplements by enhancing the delivery of

oil-loving natural health ingredients into the bloodstream. NanoPrime Labs possesses the technology to incorporate these ingredients into egg-free NanoVehicles, promoting consumer wellness and health.

7. References

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