



# CALIFORNIA SCIENCE & ENGINEERING FAIR 2019 PROJECT SUMMARY

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| <b>Name(s)</b><br><b>Levi Katriel; Krishna Nagarajan</b>  | <b>Project Number</b><br><b>J1911</b> |
| <b>Project Title</b><br><b>From Caged to Free-Range: Comparing Nutritional Profiles in Hens' Eggs</b>   |                                       |
| <p style="text-align: center;"><b>Abstract</b></p> <p><b>Objectives</b><br/>People all around the world enjoy eating eggs, but may be overwhelmed by so many choices. Free-Range? Cage-Free? Organic? To address this question, we decided to test the nutritional profiles of different types of eggs. At the outset, we expected the eggs with the best nutritional profiles to be the pasture-raised eggs because these hens have access to a varied diet.</p> <p><b>Methods</b><br/>We tested the following types of eggs: battery-cage, organic cage-free, grain-fed cage-free, free-range and pasture-raised. We ran 165 tests on 15 samples. For each sample, we measured monoglycerides, diglycerides, free fatty acids, triglycerides, sterol esters, cholesterol, cholesteryl esters, and phospholipids including phosphatidylcholine. We first weighed the eggs, separated the whites and the yolks, then the lipids were extracted from each yolk by Folch extraction. Lipids were separated and identified by thin layer chromatography to define the lipid composition described above. The chromatographed bands were then quantified using Image J.</p> <p><b>Results</b><br/>Interestingly, the results fell into two groups. Organic cage-free and pasture-raised eggs showed significant increases in sterol esters, which are thought to promote health, and significant decreases in triglycerides, which are considered less healthful. The battery-cage, grain-fed cage-free and free-range eggs contained negligible amounts of sterol esters and had increased triglycerides. We did not observe significant differences in the phospholipids or in the cholesterol levels across the egg types.</p> <p><b>Conclusions</b><br/>According to our results, organic cage-free eggs, and pasture-raised eggs have the most diverse nutritional profiles with the lowest level of triglycerides and the greatest amount of health-promoting sterol esters. Remarkably, although free-range eggs come from more humanely treated hens than battery-cage hens, the lipid profiles of their eggs were very similar, and not as diverse as the former group. We did not observe a simple correlation between the cost of the eggs and the diversity of their lipid profiles, suggesting that neither the most expensive nor the cheapest eggs would be the best choice.</p> |                                       |
| <b>Summary Statement</b><br>We measured and compared the lipid profiles for five different types of eggs: battery-cage, grain-fed cage-free, organic cage-free, free-range and pasture-raised eggs.   |                                       |
| <b>Help Received</b><br>We performed the extraction of lipids from egg yolks and the thin layer chromatography ourselves. We received some help from Professor Supriya Srinivasan at The Scripps Research Institute regarding the protocols to perform thin layer chromatography, understanding the Image J quantifications and with  |                                       |