A comparison study of egg enrichment efficiency and the bio-accessibility of bioactive compounds on farm fresh and commercial eggs

E. NOLASCO[1], E. BARAKA[1], J. YANG[1], O. N. CIFTCI[1,2], K. MAJUMDER[1].

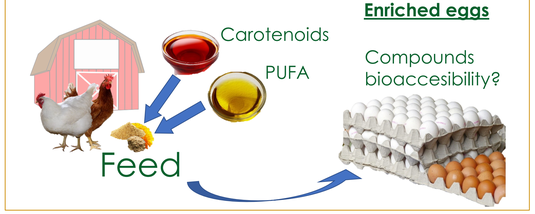
[1] Food Science and Technology, University of Nebraska-Lincoln, Lincoln, NE 68588-6205, United States

[2] Department of Biological Systems Engineering, University of Nebraska-Lincoln, Lincoln, NE, 68583-0726, United States

Contact Information:
enolasco2@huskers.unl.edu; kaustav.majumder@unl.edu

INTRODUCTION

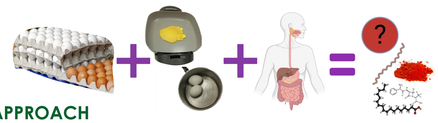
The whole egg is an essential food due to its high-quality protein, vitamins, minerals, and bioactive compounds. Enriched eggs are a convenient vehicle for dietary compounds such as carotenoids, selenium, and omega-3 fatty acids with proven health benefits.



CHALLENGES AND APPROACH

CHALLENGE

- Absence of a holistic approach to understand the combined effect of different production and processing factors on farm and commercial-derived egg bioactive compounds bioaccessibility.



APPROACH

- A Multivariate Analysis of Variance (**MANOVA**)was performed to **understand how the factors together modulate** the egg compound's bioaccessibility and antioxidant activity.

HYPOTHESIS AND AIM

Hypothesis: Shell color, diet, cooking, and gastrointestinal (GI) digestion modulate digestibility and bioaccessibility bioactive compounds.

Aim: Evaluate how processing and production factors modulate the egg digestibility and bioactive compound's bioaccessibility.

METHODS AND RESULTS

1. Degree of hydrolysis (DH) after *in vitro* gastrointestinal (GI) digestion

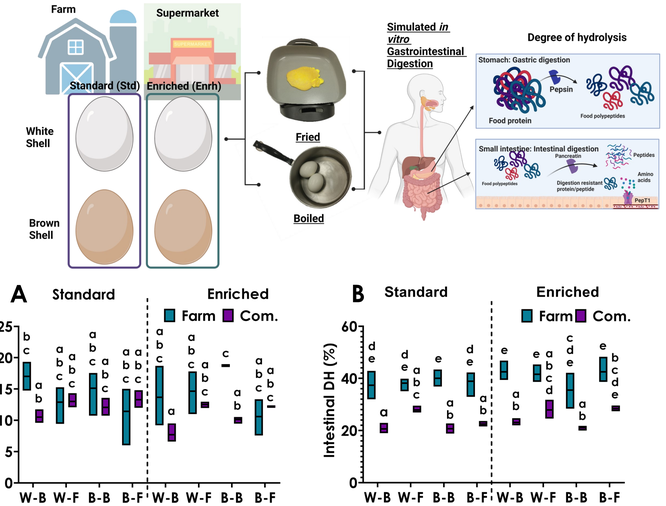


Fig. 1. Degree of hydrolysis (%) of (A) gastric and (B) intestinal phase of white and brown shell eggs from farm and supermarket through boiling and frying. **Note:** Com.: commercial, W: white shell, B: brown shell, F: fried, and B: boiled. Nomenclature: W-B: white shell boiled egg. Bars with different letters are significantly different with at a $P<0.05$ level. Error distribution is based on standard deviation.

2. Carotenoid analysis in farm and commercial whole egg

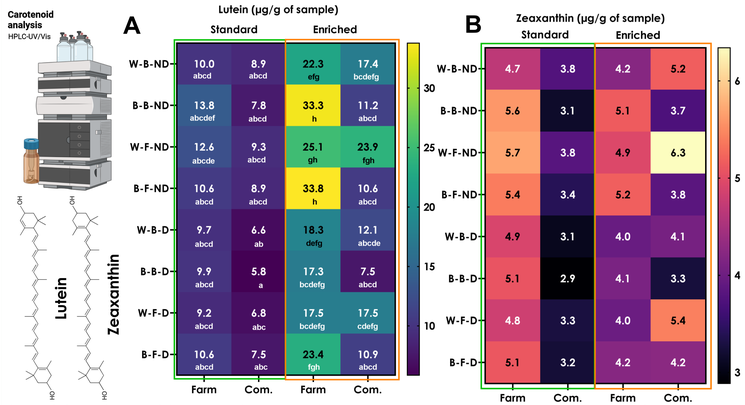


Fig. 2. (A) Lutein and (B) zeaxanthin content in cooked and egg hydrolysates. **Note**: µg/g of hydrolysate, Com.: commercial, W: white shell, B: brown shell, F: fried, and B: boiled, ND: non-digested, D: Digested. Nomenclature: W-B-D: white shell boiled egg digested. Squares with different letters are significantly different with at a $P<0.05$ level. No difference was observed in zeaxanthin.

3. Polyunsaturated fatty acids (PUFAs) content stable to GI digestion

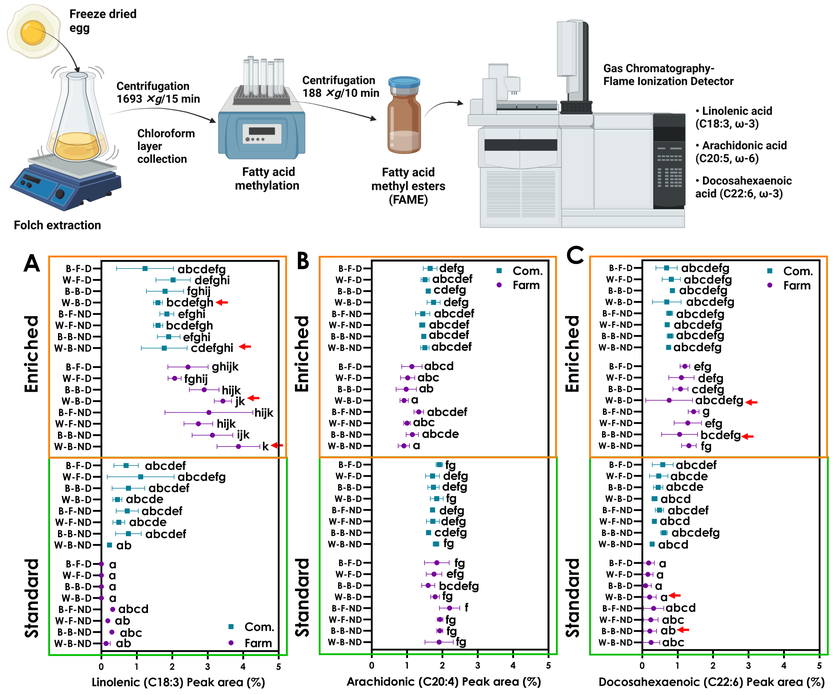


Fig. 3. (A)Linolenic (C18:3), (B)arachidonic (C20:4), and (C)docosahexaenoic (C22:6) fatty acid content in cooked and egg hydrolysates. **Note**: Com.: commercial, W: white shell, B: brown shell, F: fried, and B: boiled, ND: non-digested, D: Digested. Nomenclature: W-B-D: white shell boiled egg digested. Points with different letters are significantly different with at a $P<0.05$ level. Error bars: SD. *Red arrows* indicate highlighted groups differences in panel A and no differences in C.

4. Peptide content in whole egg hydrolysates

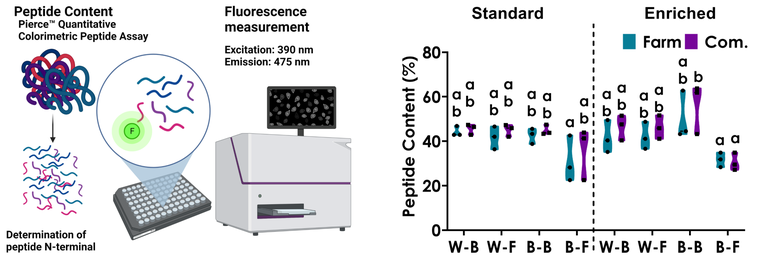


Fig. 4. Peptide content (%) of standard and enriched white and brown shell eggs through boiling and frying. **Note:** Com.: commercial, W: white shell, B: brown shell, F: fried, and B: boiled. Nomenclature: W-B-D: white shell boiled egg digested. Bars with different letters are significantly different with at a $P<0.05$ level. Error distribution is based on standard deviation.

CONCLUSIONS

- The **DH** was not affected by enrichment, shell color or cooking method but by the **egg origin** as commercial eggs had a lower intestinal DH.
- Lutein was the main enriched **carotenoid**. Farm-derived enriched brown shell eggs had higher lutein content compared to commercial eggs after digestion when fried but not boiled.
- **PUFAs:** Linolenic acid (ω-3) was the main enriched **PUFA** in farm but not commercial eggs. Farm-derived W-B enriched eggs had higher linolenic acid before and after digestion. Lower ω-6 was observed in farm-enriched eggs compared to standard eggs. Docosahexaenoic acid (ω-3) was higher in farm-derived enriched eggs. **PUFAs** were stable throughout GI digestion.
- **Peptide** content differed only between B-B and B-F commercial enriched eggs, being lower for B-F.

REFERENCES

- Nolasco, E. et al. (2021). Food Chem., 344, 128623.
- Nowacki, D. et al. (2017). Sci. Rep., 7(1), 1–11.
- Nimalaratne, C. et al. (2016). *Food Chem., 194*, 111–116.

ACKNOWLEDGEMENTS

AGRICULTURAL RESEARCH

Frank E. Mussehl and Inez L. Mussehl Poultry Research Fund.

Nebraska Poultry Industries