Nutrient Data for Whole, Large Eggs from a USDA Nationwide Sampling

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Abstract

The Nutrient Data Laboratory (NDL) collaborated with Egg Nutrition Center (ENC) in 2010 to obtain and analyze a nationwide sampling of whole, large eggs to update the egg nutrient profile in the USDA National Nutrient Database for Standard Reference (SR) (http://www.ars.usda.gov/nutrientdata). Sample units of retail whole, large eggs were obtained from 12 locations using USDA's statistically valid sampling plans previously adopted. Collaborators at Virginia Tech prepared composited samples for analysis. Sample units from each location were prepared for analysis of proximates, fatty acids, and cholesterol; composite samples from randomly selected city pairs were prepared for analysis of vitamins, minerals, and sugars. QC materials (standard reference materials and matrix-specific control materials prepared at Virginia Tech) were also analyzed to monitor accuracy and precision of measurements. Based on these analyses, the cholesterol content of large fresh eggs decreased from 423 mg/100 g in SR 22 to 372 mg/100g in SR 23, 12% lower than the previous value from a 2001/2002 sampling. Over the same time period, the level of vitamin D (82 IU [2.0 mcg]/100g) increased by 64%, and the level of vitamin B12 went down by 31%. Values in SR are used to support the combined USDA/NHANES food consumption surveys, food and nutrition policy, and consumer education.

Background

In 2009 the American Egg Board-Egg Nutrition Center (ENC) contracted with Dr. Kenneth Anderson, North Carolina State University, to compare nutrient composition of eggs from controlled cage vs. range flocks and nutrient composition and egg structural component proportions in brown and white egg strains (Anderson, K.E., personal communication). Dr. Anderson found that the cholesterol content of whole large eggs was lower than reported in USDA Nutrient Database for Standard Reference, Release 22 (SR22) in all cases. In view of the study results, Nutrient Data Laboratory (NDL) staff agreed to collaborate with ENC to conduct a new nationwide study of nutrients in eggs.

Figure 1. NFNAP Sampled Counties

Materials and Methods

Sampling

Retail sampling following the National Food and Nutrient Analysis Program (NFNAP) was utilized. NFNAP uses a probability-based sampling plan picking up food sample units from large supermarkets at 12 locations nationwide.[1,2] The previous data on eggs were determined in another NFNAP sampling in 2001/2002 in collaboration with ENC.

- Whole egg samples of regular large eggs (2 dozen) were picked up in March/April 2010 at nine of the 12 NFNAP sampling locations(Fig. 1).
- The other three samples were shipped by an ENC contact in the three locations (CA1, CA2 and CO2) where grade A large eggs were not found in NFNAP sampling locations.

Processing and analysis

The sample units were sent to the Food Analysis Laboratory Control Center (FALCC) at Virginia Tech, a NFNAP collaborator, for preparation[3]

- Proximates (moisture, protein, total fat, and ash) and cholesterol were analyzed in individual samples from each of the 12 locations.
- Vitamin D_3 and vitamin B_{12} were measured in six city-pair randomized sample units from the 12 locations.
- Methods:
  - Cholesterol: gas chromatography (AOAC 994.10 or Phillips, Ruggio, Ashraf-Khorassani J. Agric. Food Chem., 2005, 53, 9436)
  - Vitamin D_3: HPLC-UV-Vis (initial) or LC-MS-MS (later samples) (both unpublished)
  - Vitamin B12: microbiological method (AOAC 952.20).

Quality control[4]

Quality control (QC) samples from National Institute of Standards and Technology (NIST) or reference materials prepared by FALCC were included with each batch of samples.

- Cholesterol
  - Results for the QC materials met the acceptance criteria of the NDL Quality Control Panel
    - ✓Lab A: NIST SRM 1546 Meat Homogenate
    - ✓Lab B: NIST SRM 1845 Whole Egg Powder
    - ✓FALCC: NIST SRM 1546 and NIST SRM 1563 Spiked Coconut Oil
- Vitamin D_3 and Vitamin B_{12}
  - Well characterized control composites prepared by FALCC were used as the QC materials.

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Figure 2. Cholesterol results from 3 independent labs for eggs from individual locations

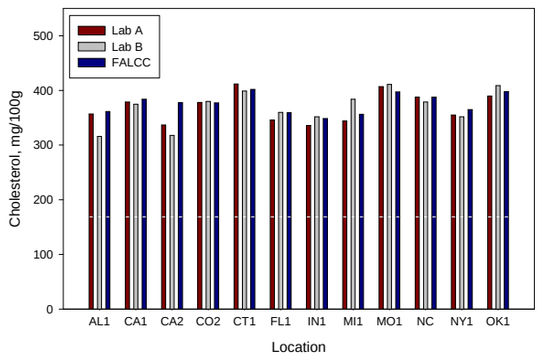

Table 1. Vitamin D_3 results on paired egg samples, and on individual locations from paired samples with high vitamin D_3 content.

	Initial Sampling			2nd Sampling	
City Pairs	Vitamin D_3 (IU)	Location	Vitamin D_3 (IU)	Location	Vitamin D_3 (IU)
IN1, NY1	348	IN1	284		
AL1, CA1	71	NY1	483	NY1	362
CA2, NC	39			NY1	259
CO2, CT1	54				
FL1, MO1	39	MI1	261		
MI1, OK1	150	OK1	48		

References

[1] Pehrsson, P.R.; Haytowitz, D.B.; Holden, J.M.; Perry, C.R.; Beckler, D.G. USDA's national food and nutrient analysis program: Food sampling. *J. Food Comp. Anal*. 2000, *13*, 379.

[2] Perry, C.R.; Pehrsson, P.R.; Holden, J.A revised sampling plan for obtaining food products for nutrient analysis for the USDA national nutrient database.*Proc. Am. Stat. Assoc*. 2003, [serial online]. Available from American Statistical Association (http://www.amstat.org/Sections/Srms/Proceedings/y2003f.html). Accessed March 18 2010.

[3] Trainer, D.; Pehrsson, P.R.; Haytowitz, D.B.; Holden, J.M.; Phillips, K.M.; Rasor, A.S.; Conley, N.A. Development of sample handling procedures for foods under USDA's National Food and Nutrient Analysis Program. *J. Food Comp. Anal*. 2010, 23, 843.

[4] Phillips. K.M., Patterson, K.Y., Rasor, A.R., Exler, J., Haytowitz, D.M., Holden, J.M., and Pehrsson, P. R. The Role of Quality Control and Reference Materials in the National Food and Nutrient Analysis Program.Anal.Bioanal. Chem., 2006, 384:1341. (DOI, 10.1007/s002-005-00294-0)

[5] American Egg Board, Cracking the Cholesterol Myth, http://www.incredibleegg.org/health-and-nutrition/cracking-the-cholesterol-myth, Accessed 3/29/11.

Results

QC and analytical results

- Data review: Katherine Phillips (FALCC) and NDL QC panel
- QC results for all nutrients were acceptable, indicating reliability of the data.
- For nutrients not discussed below, results from this study, released in SR23, were comparable to SR22 data.

Cholesterol

- Samples from all 12 locations were analyzed at Lab A (Fig. 2, red bars).
- Aliquots of the same samples were re-analyzed at Lab B and FALCC (grey and blue bars, respectively).
- Range of cholesterol values from all three laboratories was 316 to 412 mg/100g.
- Across locations, the average values ranged from 344 to 405 mg/100g.
- Computed mean value used for SR23 (372 mg/100g) is about 12% lower than SR22 value.

Vitamin D

- Six city-pair composites (randomly paired) were analyzed (see Table 1).
- Four city-pairs (AL,CA1, CA2,NC, CO2,CT1, FL1,MO1) averaged 49.2 IU/100g.
- Individual samples from city-pairs with higher values were analyzed.
  - OK1 (48 IU/100g) matches four city-pair average.
  - IN1 (284 IU/100g) and MI1 (261 IU/100g) are comparable and cartons were labeled: *5X MORE VITAMIN D PER EGG*.
  - NY1 (483 IU/100g) store was re-sampled, and new samples had 259 and 362 IU/100g with an average of 368 IU/100g. NY1 package label had no statement regarding vitamin D levels in the product.
- Final estimate was based on all samples considered to be regular eggs, i.e., not labeled: *5X MORE VITAMIN D PER EGG*.
  - Four city-pair values were double weighted, the single OK1 value was used, and the average NY1 value was used to give ten data points.
  - SR23 mean value (82 IU/100g) is about 64% higher than SR22 value.

Vitamin B_{12}

- Six city-pair values ranged from 0.65 to 1.20 mcg/100g.
- SR23 value,0.89±0.09 mcg/100g (mean±SEM), is about 31% lower than SR22 value.

Conclusions

- Cholesterol: Some researchers believe the decrease could be related to improvements farmers have been making to the hen's feed[5] ; however, there are no studies to confirm this.
- Vitamin D: ENC indicates that the increase reflects the effort on the part of some egg producers to increase the amount in eggs by supplementing the chicken feed with vitamin D.
- Vitamin B_{12}: The decrease may be due to the replacement of animal protein sources in the chicken feed with plant protein.

Impact

- All SR23 egg products that contain egg yolk, where the fat soluble cholesterol and vitamin D are found, were updated to reflect the change in values.
- NDL food specialists, who use whole eggs and other egg products as ingredients in formulations and recipes, will now use the SR23 cholesterol and vitamin D values to calculate the composition of those food items.
- The intake of vitamin D by Americans will likely increase if the feeding practice of adding vitamin D becomes widespread.
- As a result of preliminary discussions with ENC, NDL will follow up on the sampling and analysis of whole eggs to monitor levels of vitamin D in samples nationwide.