In the U.S. egg industry, anywhere from 130 million to over one billion infertile eggs are incubated each year. Some of these infertile eggs explode in the hatching cabinet and can potentially spread molds or bacteria to all the eggs in the cabinet. A method to detect the embryo development of incubated eggs was developed. Twelve brown-shell hatching eggs from two replicates (n=24) were incubated and imaged to identify embryo development. A hyperspectral imaging system was used to collect transmission images from 420 to 840 nm of brown-shell eggs positioned with the air cell vertical and normal to the camera lens. Raw transmission images from about 400 to 900 nm were collected for every egg on days 0, 1, 2, and 3 of incubation. A total of 96 images were collected and eggs were broken out on day 6 to determine fertility. After breakout, all eggs were found to be fertile. Therefore, this paper presents results for egg embryo development, not fertility. The original hyperspectral data and spectral means for each egg were both used to create embryo development models. With the hyperspectral data range reduced to about 500 to 700 nm, a minimum noise fraction transformation and a Mahalanobis Distance classification model were used to predict development. All eggs on days 2 and 3 were correctly classified (100%), while eggs from day 0 and day 1 were classified at 95.8% and 91.7%, respectively. Alternatively, the mean spectra from each egg were used to develop a partial least squares regression (PLSR) model. First, a PLSR model was developed with all eggs and all days. The data were multiplicative scatter corrected, spectrally smoothed, and the wavelength range was reduced to 539 - 770 nm. With a one-out cross validation, all eggs for all days were correctly classified (100%). Second, a PLSR model was developed with data from day 0 and day 3, and the model was validated with data from day 1 and 2. For day 1, 22 of 24 eggs were correctly classified (91.7%) and for day 2, all eggs were correctly classified (100%). Although the results are based on relatively small sample sizes, they are encouraging. However, larger sample sizes, from multiple flocks, will be needed to fully validate and verify these models. Additionally, future experiments must also include non-fertile eggs so the fertile / non-fertile effect can be determined.

Key Word:
Eggs, fertility, hyperspectral imaging, imaging spectroscopy, spectroscopy

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