APRI FACTS
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EVALUATION OF LOCAL LOBSTER SHELLS AS AN ALTERNATIVE CALCIUM SOURCE FOR LAYING HENS

Introduction: Laying hens are becoming more productive, due in large part to the great success of genetic improvements. Increased production has made the bird's nutritional demands increasingly important (Rodriguez et al. 2013). Calcium is a macro-mineral critical to produce good quality eggs. Adequate calcium is essential throughout the production cycle to ensure the hens maintain a positive calcium balance, that is, not having to deplete stored body calcium to produce eggs.

Currently ground limestone (GL) and oyster shell (OS) are the most common sources of calcium in laying hen diets. The lobster fishery in Eastern Canada generates around 335 tonnes of dried lobster shell which is a waste by-product containing approximately 17% calcium. It is also a natural source of the red pigment, astaxanthin which has been shown to be a beneficial antioxidant for humans (Guerin et al. 2003). It is possible that lobster shells are a viable, local calcium source for inclusion in poultry diets. The added benefit of the astaxanthin could potentially have positive impact on the immune system of laying hens and may also have an added benefit to human health for those consuming these eggs.

Objective: To determine the effect on production performance of commercial laying hens when using re-purposed lobster shell as the calcium source in their diets.

Trial: One hundred eighty White Leghorn hens and 180 Brown Leghorn hens were allotted to two studies. Management and data collection for each trial were identical. The birds for each trial were housed at 5 birds per cage in two three-tier cage systems. Prior to the start of the trial, all birds were fed the same diet with oyster shells and ground limestone as the calcium source. At 27 weeks of age, groups of 30 birds were each fed one of six diets, differing only in the source of calcium. Large Particle (LP) Lobster Shell and Ground Lobster Shell were compared against the industry standards. Diets containing Oyster Shell (OS), Ground Limestone (GL) and Lobster Shell represent various commercial-like combinations of large and small particle sizes of the different calcium sources. The final diet, Lobster Meal, was included as a comparison of the impact of various levels of lobster shell inclusion on egg yolk color and the presence of astaxanthin.

Figure 1. Particle Sizes of Re-Purposed Lobster Shells

0.5 - < 2 mm (LS) 0 mm – 0.84 mm (GLS)

Table 1: Treatments by Dietary Calcium Source

Treatment	Dietary Calcium Source
OS/GL	Oyster Shell + Ground Limestone
LS/GL	1/3 LP Lobster Shell + 2/3 Ground Limestone
LS/GLS/GL	1/3 LP Lobster Shell + 1/3 Ground Lobster Shell + 1/3 Ground Limestone
GL	Ground Limestone
GLS	Ground Lobster Shell
LM	6% Lobster Meal

All diets were formulated to meet the laying hen nutrient allowances for Lohmann Lite – LSL. Data was collected at the end of each of four feeding phases: 40 weeks, 50 weeks, 62 weeks and 67 weeks of age. Throughout the trial several parameters were measured including feed consumption, body weight, egg production and egg quality. Due to the presence of the red

pigment in the lobster shell, yolk pigmentation was also measured to determine the presence of the antioxidant, astaxanthin. Calcium balance was also calculated. At the end of the trial two birds per cage were euthanized and digesta samples were harvested from the gut to identify and quantify microbial populations.

Table 2: Final Body Weight and Egg Production by Diet for White Leghorns

Diet	Final Body Weight (grams)	Hen-Day Egg Production (%)
OS/GL	1806.6^{ab}	93.3^{ab}
LS/GL	1772.0^{ab}	97.0^{a}
LS/GLS/GL	1721.5^{b}	91.1^{b}
GL	1823.8^{ab}	94.5^{ab}
GLS	1758.4^{b}	92.4^{b}
LM	1915.1^{a}	95.1^{ab}

a-b Different letters are significantly different

Table 3: Final Body Weight and Egg Production by Diet for Brown Leghorns

Diet	Final Body Weight (grams)	Hen-Day Egg Production (%)
OS/GL	2045^{a}	93.7^{ab}
LS/GL	1990^{ab}	93.9^{a}
LS/GLS/GL	1922^{b}	87.9^{b}
GL	2022^{ab}	92.6^{ab}
GLS	1963^{b}	90.6^{ab}
LM	2051^{a}	91.3^{ab}

a-b Different letters are significantly different

Results: The chemical composition of lobster shell indicates that it is an excellent source of calcium, comparable to commercial oyster shell. The heavy metal analyses of all sources of calcium showed strontium to be significantly higher in oyster shell and lobster shell. Strontium has been reported to improve tibia strength (Shahnazari et al. 2006). Tibia breaking strength of the white hens fed LS/GLS/GL was significantly better than those fed GLS. There was no difference in tibia breaking strength among the brown hens.

Performance results indicate that re-purposed lobster shells, either as large particle or ground, are suitable alternative sources of calcium for both white and brown strains of laying hens. The re-purposed lobster shells in both particle sizes did not have negative effects on production performance for either strain of hen. As outlined in Tables 2 and 3, there was no difference in egg production for both white and brown hens until the last production phase when the white birds fed LS/GL produced more eggs than those fed LS/GLS/GL and GLS. The brown birds fed LS/GL produced more eggs than those fed LS/GLS/GL. There was no difference in egg weights among any of the diets for the brown and white hens. As well, body weights were highest for the white birds fed lobster meal when compared to those fed LS/GLS/GL and for the brown hens, those fed OS and LM were heavier than those fed LS/GLS/GL and GLS. In addition, both strains of hens fed the re-purposed lobster shells in both particle sizes were able to a maintain positive calcium balance. As expected, the higher the percentage content of lobster shell in the diet, the higher the astaxanthin content of the egg yolk. The analyses of gut bacteria indicated no significant shift in species that were present in the intestinal tracts of the hens due to calcium sources in the diet for both strains of hens.

Industry Impact: Feed represents between 60 and 70% of the total cost of production for poultry. Access to a high-quality calcium source that may also provide the added benefits of improved gut health, immunity and bone strength would be highly beneficial to the poultry industry in Eastern Canada. Egg producers may benefit from this new and local source of calcium in small and large particles forms to replace current sources available.

References:

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