CPRC Update – A Novel Enrichment Method of Table Eggs with Long- Chain w-3 PUFA

Omega-3 polyunsaturated fatty acids (ω-3 PUFAs) play a fundamental role in prevention of cardiovascular disease in humans. Health authorities advise people to consume ω-3-PUFAs, particularly the long chain (LC) ω-3 fatty acids eicosapentaenoic (EPA) and docosahexaenoic acid (DHA). Consumers' preference favours whole foods to supplements, and chickens are ideal for efficient transfer of ω-3-PUFA from feed to product. Fish oil and marine algae oil are currently used to facilitate enrichment of eggs with LC ω-3 PUFA. However, these products are in high demand by various industries, leaving identification of alternate sources of LC ω-3 PUFA necessary to ensure sustainability of poultry product enrichment. A new approach to increase the LC ω-3-PUFA in poultry is to use a modified form of flaxseed plant, altered to express a high proportion of steriodonic acid (SDA). Table eggs can incorporate a higher proportion of LC ω-3-PUFA than muscles, and as laying hens are capable of depositing LC ω-3-PUFA into a saleable product with less product stability challenges, they were an excellent starting point for this research.

Dr. Doug Korver and his research team from University of Alberts examined the potential of using SDA-enhanced flaxseed to substantially increase LC ω-3 fatty acids in table eggs. This approach examines the effectiveness of bypassing bioconversion of LNA by utilizing SDA-enhanced flaxseed. The goal of the project was to develop an effective SDA-enhanced flaxseed enrichment program and ensure that interactions with other dietary lipids did not interfere with SDA flax as an enrichment source.

The Experiments

Two main experiments were performed to examine the potential of including SDA-enhanced flaxseed oil in laying hens diets.

The first experiment compared the addition of SDA-enhanced flaxseed oil with conventional flaxseed oil in the diet. Additionally, it investigated the potential metabolic competition among fatty acid sources (including fish oil), and thus potential limitations of the enrichment process. Feed consumption, body weights, egg weights and egg traits were measured, and egg yolks were collected at regular intervals during the course of the 35 day experiment. On termination of the experiment, liver samples were collected to perform fatty acid analysis and ovary weight and follicle size were used to determine the reproductive status of the hens.

The second experiment tested the impact of feed form on the enrichment process of the LC ω-3 PUFAs in table eggs. This experiment compared ground SDA-enhanced flaxseed with extruded SDA-enhanced along with addition of enzymes to increase digestibility. Egg weights were measured daily. Feed consumption and body weights were measured and egg yolks collected at regular intervals during the course of the 35 day experiment. Eggs collected at day 34 were used to determine lipid stability and hence an indicator of product quality and shelf life.

The Findings

In experiment one, supplementation of experimental diets had no effect on feed intake, body weight, egg production and egg trait parameters. Egg yolks from hens fed a SDA-enhanced flaxseed diet showed a 1.5-fold increase in LC ω-3 PUFA compared with hens fed a conventional flaxseed

diet (152 mg/egg *vs.* 110 mg/egg). Additionally, changing the ratio of fatty acid sources (corn, canola, fish oil, flaxseed, SDA-flaxseed) did not result in lipid competition for bioconversion enzymes. Therefore, SDA flax can be used to enrich table eggs with LC ω-3 fatty acid regardless of other dietary oil sources.

In experiment two, extrusion and enzyme addition had no effect on feed intake, body weight, egg production or egg trait parameters. Similarly, feed processing (including enzymes) did not significantly impact egg yolk fatty acid profiles, however, egg yolk levels of ω-3-PUFA were consistently higher in eggs from hens fed SDA-enhanced flaxseed compared to conventional flaxseed. In comparison to other eggs stored for 30 days at 4°C, SDA-enhanced flaxseed enriched eggs had higher index of oxidation, suggesting additional antioxidant protection may be required in the diets of hens fed SDA-enhanced flaxseed to extend storage life of ω-3 fatty acid enriched eggs.

The results of this study show that inclusion of SDA-enhanced flaxseed oil in the diets of laying hens can increase the levels of LC ω-3 PUFA in eggs, providing an alternative to inclusion of fish oil.

The Next Steps

SDA-enriched flaxseed could be adopted by producers as an alternative to other sources of ω-3 PUFAs. Future studies will be done to determine the potential economic impact of the results obtained through cost benefit analysis and to improve the efficiency of ω-3 PUFA enrichment.

This research was funded by the Alberta Livestock and Meat Agency, the University of Alberta and Canadian Poultry Research Council (CPRC).

For more details on these or any other CPRC activities, please contact The Canadian Poultry Research Council, 350 Sparks Street, Suite 1007, Ottawa, Ontario, K1R 7S8, phone: (613) 566-5916, fax: (613) 241-5999, email: info@cp-rc.ca, or visit us at www.cp-rc.ca.

The membership of the CPRC consists of Chicken Farmers of Canada, Canadian Hatching Egg Producers, Turkey Farmers of Canada, Egg Farmers of Canada and the Canadian Poultry and Egg Processors' Council. CPRC's mission is to address its members' needs through dynamic leadership in the creation and implementation of programs for poultry research in Canada, which may also include societal concerns.