Local Grains and Free-Choice Feeding of Organic Layer Hens on Pasture at UBC Farm

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Introduction

Free-range and organically produced eggs are growing segments of the egg market both in British Columbia and in Canada as a whole. Analysis of the 2008 AC Nielsen retail data indicates that free-range and organically produced eggs increased from 14% of the BC retail egg market in 2006 to 17% in 2008 (Bejaei 2009). However, these estimations likely under predict the size of this market segment. In a recent survey of BC residents, nearly one third of respondents who purchased free range eggs indicated that they bought the eggs directly from the farm or from farmers markets (Bejaei 2009). Since most of the free-range and organic eggs are produced on small scale farms, these producers play a significant role in the BC specialty egg market.

A major concern to the profitability of these farms is the high cost and availability of suitable feed ingredients. Feed costs represent 60-70% of the production costs of eggs (Leeson and Summers, 1997; Sainsbury, 2000). The use of high quality locally grown feed combined with choice-feeding systems may provide a solution.

Commercial laying hens are typically fed complete diets (i.e. mash and pelletized feeds) that are produced to optimize the nutrient content based upon the dietary requirements of an 'average' hen. However dietary needs can vary dramatically depending on the hen's level of production and activity, environmental factors, such as ambient temperature and weather, and on the availability and type of range forage.

Choice feeding systems offer several advantages, many of which can effectively reduce overall feed costs (Henuk and Dingle 2002). Under these systems, birds are typically offered a choice between different types of feedstuffs: an energy source (grain), a protein source supplemented with vitamins and minerals, and calcium in granular form. The hen then selects the optimal amount of each component to satisfy her individual nutrient requirements. This self-selection results in a reduction in feed intake (Henuk and Dingle 2002), but impact on egg production can be variable. Blair (2008) points out that hens can successfully consume 70% of

their diet as whole grain when it is choice fed. This provides further economic benefits as it reduces grinding and handling costs. Finally, because feed components are presented to the hens separately, the growers have the option to find feed components individually, presented an additional opportunity to reduce feed prices through local or on-farm production of grains or protein components.

The objective of this study was to evaluate the effects of free-choice feeding systems on egg production and hen health in a small-scale organic farm system. We did this by comparing production rates, bird weights, and feed consumption of hens fed a whole grain, free-choice diet, with hens fed a crushed grain mash diet. The 2013 trial is the second full season

Material and Methods

This study was conducted at the Centre for Sustainable Food Systems of the University of British Columbia (UBC) in Vancouver B.C., Canada, and was run over the summer and fall months of 2013. Hens were maintained in accordance with the guidelines of the Canadian Council of Animal Care and the COABC Standards and Practices. All procedures were approved by the UBC Animal Care Committee (Certificate #A07-0012).

Experimental Birds

One hundred twenty Hy-Line Brown Commercial layers were used in this study. These were obtained as 20-wk old pullets from a local commercial supplier (In-Season Farms Inc., Abbotsford, BC, Canada). All birds were banded with numbered leg bands and were divided into six groups of 20 birds each. Hens were housed in moveable hen-houses that provided at least 0.2 m^2 of floor space and 0.25 m of roost space per bird. The dimensions were based upon the COABC and SPCA minimum indoor and outdoor space requirements.

The pens were maintained on a pasture of mixed ryegrass, ladino clover and crimson clover and were rotated around a pasture twice per week. Birds were given daily access to their runs from approximately 08:30 to 21:30 local time, but were locked in their shelters at night.

Experimental diets

All hens were initially fed an organic 16% protein layer-mash (In-Season Farms Inc.,

Abbotsford, BC, Canada), consisting of cracked grains, legumes, soy, and canola meal. After a one week acclimation period to the experimental setup, hens in three of the six pens were placed on the experimental free-choice diet (Experimental group). This diet consisted of separate portions of whole wheat kernels and a 35% protein source (peas, soy, and flax plus vitamin-mineral premix; In-Season Farms Inc., Abbotsford, BC, Canada). To allow the Experimental group hens to transition to this free-choice diet, the organic 16% protein layer-mash was also provided, but was phased out over a one week period. The remaining three pens (Control group) remained on the organic 16% protein layer-mash (control diet). Nutrient analysis of the feed is presented in Table 1.

Production

Over the 16-week trial period, body weight, feed intake and egg production were measured. Body weights of individual hens were measured monthly, in the morning prior to the hens being released into their outdoor runs. Feed intake on a pen basis was measured weekly. Daily egg production per pen was recorded. At least once per week, all the eggs laid on one day were weighed on a pen basis. Once per month, 12 eggs per pen were randomly collected, weighed and stored overnight at 4°C. Eggs were broken out onto a level glass surface and the height of the albumen measured using a standard tripod micrometer. The yolk was weighed and its color measured with a Roche yolk color fan scale (Roche scale). Shells were washed, dried, and weighed. The albumen mass was then calculated by difference.

Statistical Analyses

Data are reported as means ± standard errors and were analyzed by repeated-measures ANOVA using SYSTAT 9 for Windows (SPSS Science, Chicago, IL). Significance was accepted when $P<0.05$.

Results and Discussion

Vancouver experienced a hotter and drier summer than normal, and a mild dry autumn.

Body weight

Body weight did not differ significant between hens on the two treatments at the start of the trial (Fig. 1). Throughout the experimental period, body weight of hens on the experimental free-choice diet were significant greater than that of the hens receiving the control diet.

Feed intake and Egg Production

Hens fed the free-choice diet consumed more feed (Fig. 2), but laid more eggs that were larger (Fig. 3) than hens fed the control diet during the hot dry summer (Weeks 1-8, July-Aug). There was no difference in feed conversion between the two dietary groups during this period (Fig. 2).

Feed intake (Fig. 2) and egg production (Fig. 3) of hens fed the control diet increased significantly during September and October (Weeks 9-17), when the weather was cooler, such that there were no significant differences observed between the two dietary groups. Hens fed the free-choice diet continued to lay larger eggs than hens consuming the control diet (Fig. 3).

The amount of protein concentrate consumed by hens fed the free-choice diet did not vary significantly during the experimental period (Fig. 4), and was significantly related to egg weight ($r = 0.33$, $P = 0.02$). Grain intake varied significantly during the experimental period (Fig. 4). We are currently exploring the relationships between feed intake, egg production and size, and weather.

Egg Quality

Egg quality and nutrient analysis was measured at monthly intervals throughout the experimental period. Egg weight of the sampled eggs did not differ significantly between the treatments during the trial (Table 2), and increased through the experimental period (Fig. 5). Similarly there was no significant difference in yolk and albumin weight. However, egg shell weight of hens fed the experimental free-choice diet was significantly lower than the egg shell weight of hens fed the control diet. This suggests that hens fed free-choice may not have obtained enough calcium. We recommend that a supplementary calcium source should be

provided to hen fed free-choice diets. Yolk colour did not differ significantly between the treatments during the trial (Table 2). Albumin protein concentration and yolk cholesterol concentration did not differ significantly between the treatments (Table 2).

Economics

We assess the economic benefits of free-choice feeding systems for use in small-scale organic farm systems, based on current feed prices obtained from In Season Farms (Layer Mash Diet: $850/ton; Whole Wheat: $750/ton; Protein Concentrate: $1500/ton), the feed intake patterns observed in this study (Fig. 2), and the price that UBC farm eggs sold for ($7/dz).

Overall feed costs were significantly greater for hens fed the free-choice diet (Fig. 6). During the summer months (Weeks 1-8, July-Aug) egg production (Fig. 2) and hence egg revenue (Fig. 6) of hens fed the experimental free-choice diet was greater than that of hens fed the control layer-mash diet. The net effect was that hens fed the free-choice diet generated significantly more revenue over feed costs, compared to hens fed the control layer-mash diet (Fig. 6).

With the increased egg production (Fig. 3) in hens fed the control diet, there was no difference in egg revenue between the two groups September and October (Weeks 9-17). There was also no difference in the amount of revenue generated over feed costs between the two groups (Fig. 6).

There is also the potential to reduce feed prices on free choice diets. Since feed components are presented to the hens separately, producers have the option to source feed components individually. This gives the opportunity to utilize ingredients produced on-farm, or to purchase them when they are cheaper or from local farmers, and thus avoid the fluctuations in the commodity markets.

Recommendations:

We feel satisfied with the results evaluating free-choice feeding for organic laying hens on pasture after this trial. Future trials should be focused on evaluating free-choice feeding with pasture-raised broilers, alternative feed ingredients and in commercial poultry barns. Free-choice feeding should also be evaluated in a system where the feed components are changed on a regular basis, because during this trial the feed components were kept constant throughout the trial. This would be to evaluate the birds' ability to adjust their intake based on changing

components. Additional research should be focused on alternative and locally produced protein sources. There is potential to be evaluated in various legumes and black solider fly larva.

This project was made possible by support from the Organic Sector Development Program funded by the Canadian Agriculture Adaptation Program administered by Investment Agriculture Foundation. Funding was also provided by the Centre for Sustainable Food Systems at UBC Farm, and the W.A.U. Nicoll Robertson Charitable Foundation Trust.

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Table 1. Nutrient composition of experimental diets.

	Control	Experimental (Free Choice)	
	(complete diet)	Grain	Protein Conc.
Moisture (% as fed)	10.3	11.4	5.5
Protein (% DM)	20.7	16.7	28.2
Fat (% DM)	4.7	3.5	7.8
Carbohydrates (% DM)	47.1	77.7	21.7
Ash (% DM)	27.4	2.0	42.3
Gross Energy (kcal/kg)	3142	4095	2699

Table. 2. Egg quality and nutrient content of hens fed either a 16% protein layer-mash (control complete diet) or separate portions of whole grains and a 35% protein source (experimental free-choice diet).

	Control diet	Experimental diet
Egg weight (g)		
Whole egg	59.8 ± 0.5	59.5 ± 0.6
Albumen	39.5 ± 0.3	39.5 ± 0.4
Yolk	14.2 ± 0.2	14.2 ± 0.2
Shell	6.0 ± 0.1	5.8 ± 0.2
Albumen height (mm)	8.8 ± 0.1	8.9 ± 0.1
Yolk colour	9.4 ± 0.1	9.8 ± 0.1
Albumin protein content (mg/g)	112.8 ± 1.8	111.4 ± 2.0
Yolk cholesterol content (mg/g)	10.1 ± 0.5	10.3 ± 0.5

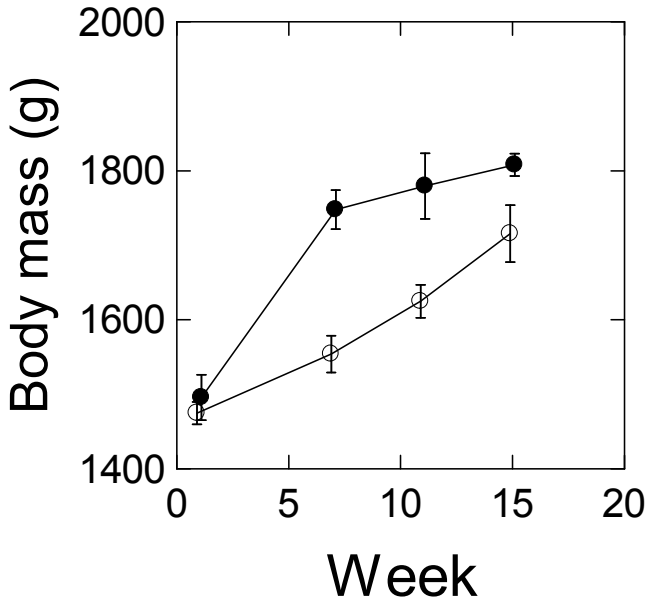

Fig. 1. Body weight of hens fed either a 16% protein layer-mash (control complete diet, open symbols) or separate portions of whole grains and a 35% protein source (experimental free-choice diet, filled symbols).

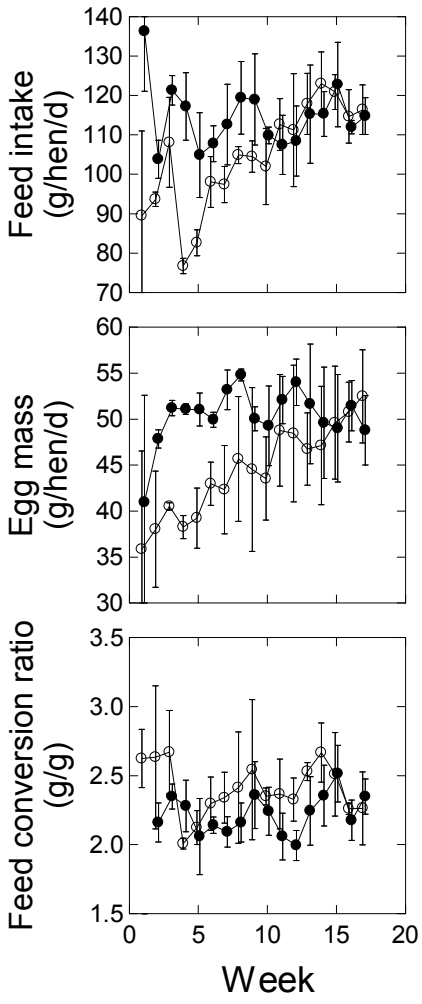

Fig. 2. Feed intake of hens fed either a 16% protein layer-mash (control complete diet, open symbols) or separate portions of whole grains and a 35% protein source (experimental free-choice diet, filled symbols).

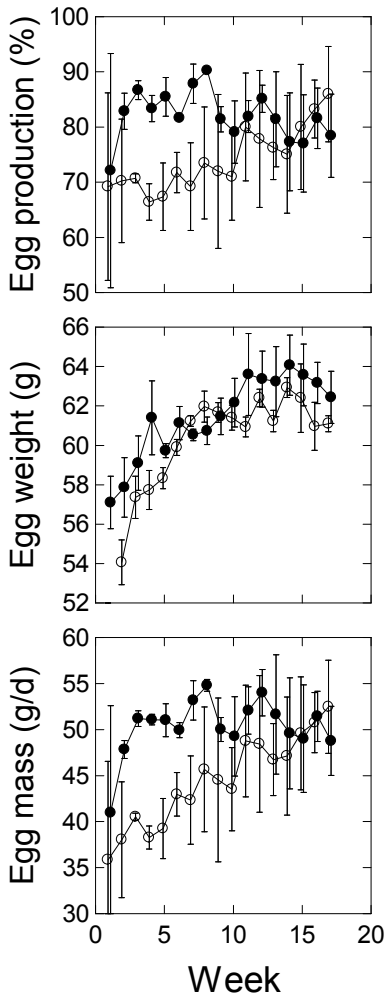

Fig. 3. Egg production of hens fed either a 16% protein layer-mash (control complete diet, open symbols) or separate portions of whole grains and a 35% protein source (experimental free-choice diet, filled symbols).

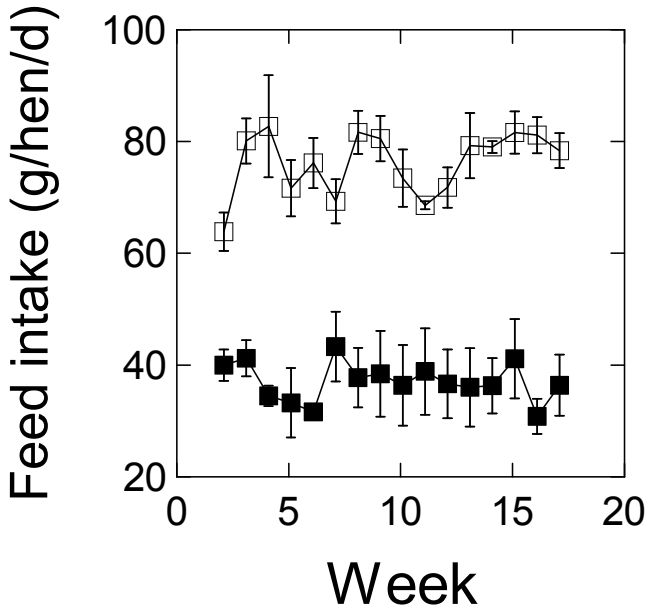

Fig. 4. Feed intake of hens fed the free choice diet consisting of separate portions of whole grains (open symbols) and a 35% protein source (filled symbols).

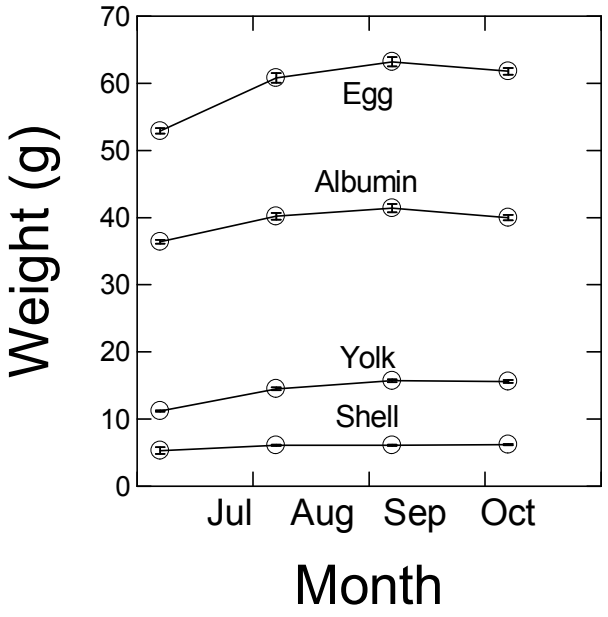

Fig. 5. Body weight of hens fed either a 16% protein layer-mash (control complete diet, open symbols) or separate portions of whole grains and a 35% protein source (experimental free-choice diet, filled symbols).

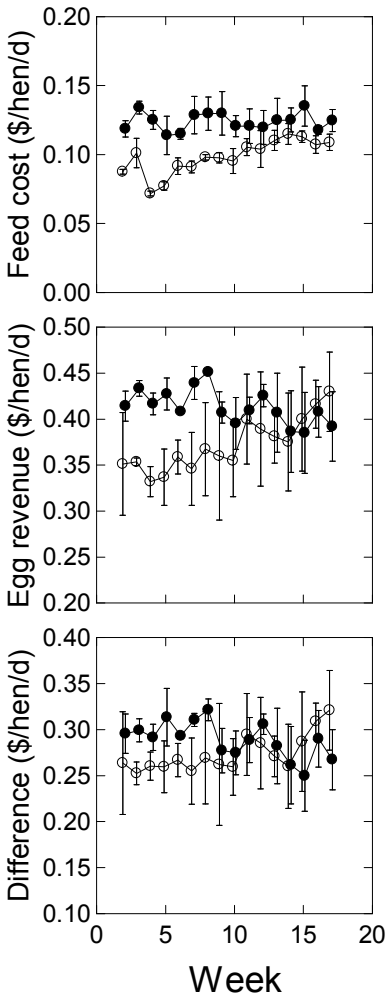

Fig. 6. Economics of egg production of hens fed either a 16% protein layer-mash (control complete diet, open symbols) or separate portions of whole grains and a 35% protein source (experimental free-choice diet, filled symbols).