Egg fatty acid composition, nutrient intake, feed conversion efficiency and egg production of layers fed organic and inorganic chromium supplements

(Kandungan asid lemak, pengambilan makanan, kecekapan penukaran makanan dan pengeluaran telur daripada ayam penelur yang diberi makan makanan tambahan kromium organik dan tak organik)

H.K. Wong* and E.A. Engku Azahan*

Key words: chromium supplement, feed intake, egg production, layers, fatty acid

Abstract
The effects of inorganic chromium chloride (CrCl$_3$.6H$_2$O) and organic Cr-yeast supplements on feed intake, egg production and fatty acid composition of eggs were studied over two periods (P1 = Bird age 25–30 weeks, P2 = Bird age 31–36 weeks). Lohmann brown layers (aged 24 weeks) were allocated the following five dietary treatments: T1 = Control diet, T2 = Control diet supplemented with 400 ppb Cr from CrCl$_3$.6H$_2$O, T3 = Control diet supplemented with 800 ppb Cr from CrCl$_3$.6H$_2$O, T4 = Control diet supplemented with 400 ppb Cr from Cr-Yeast, and T5 = Control diet supplemented with 800 ppb Cr from Cr-Yeast.

No significant treatment differences ($p>0.05$) were observed for daily and total feed intake, egg production, total egg produced and feed conversion efficiency. Significant differences ($p<0.05$) between T4 and the control were only observed for mean egg weight and total egg weight in P2 but not in P1. There were no significant differences ($p>0.05$) between treatments in daily bird metabolizable energy (ME) intake, ME intake/kg egg, crude protein (CP) intake and CP intake/kg egg in P1 and P2. However, differences in daily bird ME and CP intake between P1 and P2 were significant ($p<0.05$) for all treatments. Significant differences ($p<0.05$) between periods were also observed for ME and CP intake/kg egg in T5 but not for the other four treatments.

There were no significant differences ($p>0.05$) in mean fat content (g/egg) between treatments in P1. However, in P2, egg fat content in T4 was significantly lower ($p<0.05$) than the control. No significant differences ($p>0.05$) were observed for mean egg monounsaturated fatty acid (MUFA) and polyunsaturated fatty acid (PUFA) content (%) between treatments in P1 and P2. There were also no significant differences ($p>0.05$) in mean egg saturated fat content (%) between treatments in P1. However, for P2, egg saturated fat content was significantly lower ($p<0.05$) in T3, T4 and T5 compared to the control. Supplementation with organic or inorganic Cr was not effective in enhancing egg production, feed conversion or nutrient utilization. Organic Cr-Yeast supplementation can however enhance egg quality through reductions in total egg fat and saturated fat.

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Introduction
For the last several decades poultry nutritionists have been studying not only strategies to improve production efficiency, but also scientific approaches to improve the nutritional profile of poultry meat and eggs (Wong 1997; Lyons 1998; Sim 1998; Wong and Tan 2003) as these profiles relate to human health and consumer demand. In recent years there has been considerable research interest on the use of chromium (Cr) in poultry feed to improve production and egg quality, and reduce cholesterol content.

Chromium is a nutrient involved in the regulation of carbohydrate and lipid metabolisms. In addition to its effects on glucose, insulin, and lipid metabolisms, Cr has been reported to increase lean body mass and decrease percentage of body fat, which may lead to weight loss in humans (Anderson 1988; Vincent 2000). Chromium, as an integral component of the glucose tolerance factor (GTF), helps to control appetite, hypoglycemia and protein uptake, and plays a protective role against heart disease and diabetes (Mertz 1993; Vincent 2000). The hormone insulin regulates energy metabolism, muscle tissue deposition, fat metabolism and cholesterol utilisation. Glucose that cannot be utilised by body cells due to low insulin activity is then converted into fat cells.

Increasing supplemental Cr increases live weight gain, feed efficiency and egg production in layers (Sahin et al. 2001). In addition, Cr picolinate and vitamin C supplementation improve the digestibility of nutrients (dry matter, organic matter, crude protein and ether extract) as well as increase live weight, egg weight, egg production and improve feed efficiency in cold stressed birds (Sahin, Onderci at al. 2002; Sahin, Sahin and Kucuk 2002). In broilers, Cr picolinate improves feed consumption, weight gain and decreases abdominal fat and serum fatty acids (Lien at al. 1999). In addition, Cr supplemented birds had increased serum HDL contents and reduced serum VLDL and LDL contents. Under heat stress, laying Japanese quail fed supplemental Cr showed increased body weight, feed intake and egg production, improved feed efficiency and increased egg weight, eggshell thickness, egg specific gravity and Haugh unit (Sahin, Ozbey et al. 2002).

Hossain (1998) in his review of the effects of Cr on poultry concluded that trivalent Cr is biologically active in poultry and its beneficial effects include improved growth rate and feed efficiency, increased rates of lipogenesis, increased breast meat yield, reduced carcass fat in broilers, reduced mortality of broilers reared under high environmental temperatures, increased egg albumen quality and reduced blood cholesterol in laying hens. Published data on the use of organic and inorganic Cr on egg quality and composition are still scarce and this study was conducted to evaluate the effects of Cr yeast and Cr chloride supplements on the feed intake, egg production, feed efficiency, energy and protein utilization as well as the lipid composition of eggs.

Materials and methods
A total of 150 Lohmann brown layers (aged 24 weeks, six pullets per replicate and five replicates per treatment) under open housing were kept in individual cages and fed the ration shown in Table 1 and formulated according to the nutrient requirements of Lohmann brown layers (Anon. 1999). The birds were allocated the following five dietary treatments: T1 = A typical corn-soybean meal based control diet, T2 = Control diet supplemented with 400 ppb inorganic Cr from CrCl₃·6H₂O, T3 = Control diet supplemented with 800 ppb inorganic Cr from CrCl₃·6H₂O, T4 = Control diet supplemented with 400 ppb organic Cr from Cr-Yeast, and T5 = Control diet supplemented with 800 ppb organic Cr from Cr-Yeast.

In period 1 (P1), feed intake data for each replicate were collected weekly over
H.K. Wong and E.A. Engku Azahan

the first 6 weeks (25–30 weeks) to give weekly means. Weekly feed intake data was then pooled to give mean feed intake for each replicate for P1. Eggs were collected and counted daily. All eggs produced on day 7, 14, 21, 28, 35 and 42 were weighed and then pooled to give mean egg weight for each replicate for P1. Two eggs from each replicate (10 eggs per treatment) from day 42 of P1 were taken for lipid analysis. Apparent ME digestibility of the test diet was determined separately by total collection procedure (Schnieder and Flatt 1975) on six pullet layers kept in individual cages.

After a 2-week adaptation period on the test diet, the total collection procedure was used to measure daily feed intake, feed residue and faecal output over a 7-day period. The apparent ME and protein content of the test diet were then used for calculation of the ME and CP intake. The feeding trial was repeated for the next 6 weeks which made up P2 (31–36 weeks). Total lipids were extracted from egg yolks according to the method of Folch et al. (1957) and methylated according to the method of Metcalfe et al. (1961) and analysed by gas chromatography (Shimadzu GC 17A) with a flame ionisation detector using an SP-2380 (Supelco) column (30 m x 0.25 mm). Fatty acid methyl esters standards were purchased from Sigma. Chemical analyses of energy, fat and protein from the feed and faecal samples were as those recommended by AOAC (1975). The fatty acid contents of the eggs from each treatment were then grouped as either monounsaturated (MUFA), polyunsaturated (PUFA) or saturated (SAT). Data were subjected to analysis of variances using SAS (1985).

Results

Feed intake, egg production and FCR (comparison between treatments)

In P1, no significant differences ($p >0.05$) in daily bird feed intake and total feed intake were observed between the supplemented groups and control. However, significant differences ($p <0.05$) were observed between T2 and T5. For P2, no significant differences ($p >0.05$) in daily and total feed intake were observed between treatments. Egg production (%) and total eggs produced were not significantly different ($p >0.05$) between the control and supplemented groups in P1 and P2, while significant differences were observed when T3 was compared to T4 and T5 in P1. In P2, egg production (%) and total eggs produced were significantly lower ($p <0.05$) in T3 compared to T4 (Table 2).

There were no significant differences ($p >0.05$) in egg weights between the supplemented groups and the control in P1. However, significant differences ($p <0.05$) were observed only between T3 and T4 in P1. For P2, egg weight was highest in T4 and this was significantly different ($p <0.05$) to the control and T3 and T5. In P1, total egg weights were significantly lower

Table 1. Composition of the experimental control diet

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maize (%)</td>
<td>48.6</td>
</tr>
<tr>
<td>Soybean meal (%)</td>
<td>25.6</td>
</tr>
<tr>
<td>Rice bran (%)</td>
<td>12.5</td>
</tr>
<tr>
<td>Crude palm oil (%)</td>
<td>1.0</td>
</tr>
<tr>
<td>Limestone (%)</td>
<td>10.0</td>
</tr>
<tr>
<td>Dicalcium phosphate (%)</td>
<td>0.3</td>
</tr>
<tr>
<td>Fishmeal (%)</td>
<td>1.0</td>
</tr>
<tr>
<td>Salt (%)</td>
<td>0.3</td>
</tr>
<tr>
<td>NaHCO$_3$ (%)</td>
<td>0.1</td>
</tr>
<tr>
<td>Mineral and vitamin premix</td>
<td>0.3</td>
</tr>
<tr>
<td>DL-Methionine (%)</td>
<td>0.19</td>
</tr>
<tr>
<td>Choline chloride (%)</td>
<td>0.04</td>
</tr>
</tbody>
</table>

1Nutrient composition
2ME (MJ/kg) 11.4
3CP (%) 17.8
Calcium (%) 3.8
Total phosphorus (%) 0.58
Lysine (%) 0.91
Methionine + Cystine (%) 0.73
Linoleic (%) 1.53
Na (%) 0.18
Choline (mg/kg) 1 500

1Calculated value; 2Value from digestibility determination; 3Analysed value
Table 2. Comparison of feed intake, egg production and feed conversion ratio of layers fed Cr supplements (between 2 periods and 5 treatments)

<table>
<thead>
<tr>
<th></th>
<th>Period</th>
<th>T1</th>
<th>T2</th>
<th>T3</th>
<th>T4</th>
<th>T5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Feed intake (g/b/day)</td>
<td>1</td>
<td>105.14abx</td>
<td>105.90ax</td>
<td>104.54abx</td>
<td>105.76abx</td>
<td>104.29bx</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>110.44y</td>
<td>110.65y</td>
<td>109.61y</td>
<td>111.52y</td>
<td>110.41y</td>
</tr>
<tr>
<td>Total feed intake (kg)</td>
<td>1</td>
<td>132.47abx</td>
<td>133.43ax</td>
<td>131.70abx</td>
<td>133.25abx</td>
<td>131.40bx</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>139.15y</td>
<td>139.40y</td>
<td>138.10y</td>
<td>140.50y</td>
<td>139.10y</td>
</tr>
<tr>
<td>Total egg produced</td>
<td>1</td>
<td>1 141ab</td>
<td>1 142ab</td>
<td>1 132b</td>
<td>1 145a</td>
<td>1 145a</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>1 145ab</td>
<td>1 142ab</td>
<td>1 135b</td>
<td>1 150a</td>
<td>1 145ab</td>
</tr>
<tr>
<td>Egg prod. (%)</td>
<td>1</td>
<td>90.55ab</td>
<td>90.63ab</td>
<td>89.80b</td>
<td>90.86a</td>
<td>90.86a</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>90.90ab</td>
<td>90.64ab</td>
<td>90.08b</td>
<td>91.26a</td>
<td>90.88ab</td>
</tr>
<tr>
<td>Mean egg wt. (g)</td>
<td>1</td>
<td>57.15abx</td>
<td>56.92abx</td>
<td>56.32bx</td>
<td>57.53ax</td>
<td>57.06abx</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>59.45by</td>
<td>59.71aby</td>
<td>59.00by</td>
<td>60.51ay</td>
<td>59.37by</td>
</tr>
<tr>
<td>Total egg wt. (kg)</td>
<td>1</td>
<td>65.20ax</td>
<td>65.00abx</td>
<td>63.72bx</td>
<td>65.90ax</td>
<td>65.30ax</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>68.10by</td>
<td>68.20by</td>
<td>67.00cy</td>
<td>69.60ay</td>
<td>68.00by</td>
</tr>
<tr>
<td>Feed Conversion Ratio (FCR)</td>
<td>1</td>
<td>2.03abc</td>
<td>2.05ab</td>
<td>2.07a</td>
<td>2.02bc</td>
<td>2.01cx</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>2.04ab</td>
<td>2.04ab</td>
<td>2.06a</td>
<td>2.03b</td>
<td>2.05aby</td>
</tr>
</tbody>
</table>

abcd Significantly different (p < 0.05) between treatments within period
xy Significantly different (p < 0.05) between periods within treatment

(p < 0.05) between T3 and T1, T4 and T5. For P2, total egg weight was highest in T4 and was significantly different (p < 0.05) from the other treatments. Total egg weight in T3 was significantly lower (p < 0.05) than the control and T2 and T5.

In P1 and P2, FCR (feed conversion ratio) were not significantly different (p >0.05) between the control and the supplemented groups. The FCR in T3 was significantly higher (p <0.05) than those of T4 and T5 in P1. For P2, significant differences were only observed between T3 and T4.

**Feed intake, egg production and FCR (comparison between periods)**

There were significant differences (p <0.05) in daily bird feed intake, total feed intake, mean egg weights and total egg weights between P1 and P2 for all treatments. However, no significant differences (p >0.05) were observed for egg production (%) and total egg produced between P1 and P2 for all treatments. A significant difference (p <0.05) between periods was observed for FCR in T5, but not for the other four treatments.

**ME and protein intake (comparison between treatments)**

There were no significant differences (p >0.05) between treatments in daily bird ME intake and ME intake/kg egg in P1 and P2. However, significant differences (p <0.05) for ME intake/kg egg were observed between T3 and T4 and T5 in P1. For P2, significant differences (p <0.05) were observed between T3 and T4. There were no significant differences (p >0.05) between the control and the supplemented groups in daily bird CP intake and CP intake/kg egg in P1 and P2. However, significant differences (p <0.05) in CP intake/kg egg were observed between T3, T4 and T5 in P1. For P2, significant differences (p <0.05) in CP intake/kg egg were observed between T3 and T4 (Table 3).

**ME and protein intake (comparison between periods)**

Daily bird ME and CP intakes between P1 and P2 were significantly different (p <0.05) for all treatments. However, significant differences (p <0.05) between periods were only observed for ME and CP intake/kg egg in T5, but not for the other four treatments.
In P1, there were no significant differences \((p > 0.05)\) in mean fat content \((g/egg)\) between treatments although T4 had the lowest egg fat content. In P2, the lowest egg fat content was also observed in T4 and this value was significantly lower \((p < 0.05)\) than that of the control. Numerically, egg fat content was highest in the control, but this value was not significantly different \((p > 0.05)\) from those of T2, T3 and T5 for both periods (Table 4).

In P1 and P2, no significant differences \((p > 0.05)\) were observed for mean egg MUFA and PUFA content \(\%\) between treatments. In P1, there were also no significant differences \((p > 0.05)\) in mean egg saturated fat content \(\%\) between treatments. For P2, egg saturated fat content was significantly lower \((p < 0.05)\) in T3, T4 and T5 compared to the control. Egg saturated fat content was also significantly lower \((p < 0.05)\) in T4 and T5 compared to that of T2.

**Lipid composition (comparison between treatments)**
Egg fat was significantly different \((p < 0.05)\) for all treatments between P1 and P2, but no significant differences \((p > 0.05)\) for all treatments were observed between P1 and P2 for egg MUFA and PUFA content. Significant differences \((p < 0.05)\) were however observed for egg saturated fat content between P1 and P2 for T3, T4 and T5.
Discussion
Supplementation with 400 and 800 ppb organic and inorganic Cr had no adverse effect on daily and total feed intake of the supplemented groups compared to the control. Although significant differences ($p < 0.05$) were observed between T2 and T5 in P1 these differences were small and considered to be experimental observations. Chromium supplementation did not increase egg production (%) and total eggs produced as no significant differences ($p > 0.05$) were observed between the control and supplemented groups in P1 and P2. The feed intake and egg production data obtained were comparable to those reported in the management guidelines for this breed (Anon. 1999) and other commercial layer breeds used locally (Anon. 2000; 2001). The significantly lower ($p < 0.05$) egg production and total eggs produced observed in T3 compared to T4 and T5 in P1 suggested that organic Cr supplementation could enhance egg production better than inorganic Cr (800 ppb). This was also observed in P2 where egg production (%) and total eggs produced were also significantly lower ($p < 0.05$) in T3 compared to T4.

It can be concluded that there were no benefits in higher levels of inorganic Cr supplementation, and organic Cr was a better supplement than the inorganic form. Anderson (1988) has reported that inorganic Cr compounds are poorly absorbed and poor Cr absorption could be the cause of less efficient egg production in the inorganic Cr group. Uyanik et al. (2002) in their study on broilers reported no improvement in weight gains with increasing dietary levels of 20–80 ppm of inorganic Cr, but observed improvement in cell-mediated response.

Chromium supplementation did not improve mean egg weights in P1. The significantly higher ($p < 0.05$) egg weights in T4 compared to T3, suggested that organic Cr enhance egg weight better than incorporation of higher inorganic Cr. In P2, the significantly higher ($p < 0.05$) egg weights in T4 suggested that longer-term organic Cr supplementation could improve egg weights compared to the control. The significant differences ($p < 0.05$) between T4 compared to T3 and T5 suggested that longer-term supplementation with higher levels of Cr (800 ppb) decreased egg weights. By contrast, Sahin et al. (2001) reported that increasing supplemental Cr picolinate increases live weight change, feed efficiency and egg production of Ross brown hens under low ambient temperature ($6.9 \, ^{\circ}C$). The differences with the present study may be due to the differences in the form of Cr used and the environmental temperature as the present study was conducted in open housing with temperature range of 25–32 $^{\circ}C$.

The significantly lower ($p < 0.05$) total egg weights in P1 and P2 for T3 compared to the control suggested that high inorganic Cr supplementation could have detrimental effects. By contrast, organic Cr supplementation at 400 ppb could enhance total egg weights and there were no further benefits to increasing organic Cr supplementation to 800 ppb.

The non-significant differences ($p > 0.05$) in FCR between treatments suggest that although T4 produced significantly higher total egg weights compared to the control, this improvement was due to increased feed intake. The lower egg production and egg weights in T3 have resulted in the highest FCR (least efficient) compared to the control and T4 in P1 and P2. Supplementation with high levels of inorganic Cr, whilst having no adverse effects on feed intake, could however depress egg production and egg weights resulting in less efficient FCR. The results obtained in this study are comparable to those reported by Nakaue and Hu (1997) who conducted a similar experiment with young (22 to 38 weeks) and old (75–91 weeks) layers using 0, 200 and 800 ppb Cr from Cr picolinate. They reported no differences in egg production, feed efficiency, Haugh units or blood.
triglycerides between treatments in both the young and old layers.

Under hot environments, Sahin, Ozbey et al. (2002) reported that Cr picolinate supplementation could alleviate the negative effects of heat stress (32.5 °C) on egg production, feed efficiency and egg quality of laying Japanese quail. These differences from our study are due to the different avian species and type of Cr supplements used. Page et al. (1991) reported that 200 ppb dietary Cr from Cr picolinate in layer diets increased egg production, but no further improvements were seen at higher Cr levels at 400 and 800 ppb. In contrast, Sahin, Ondercei et al. (2002) reported that Cr picolinate increased body weight and improved feed efficiency and concluded that Cr supplementation at 1200 ppb can alleviate the detrimental effects of heat stress in broilers.

There were significant differences ($p < 0.05$) for bird daily and total feed intake, mean and total egg weights between P1 and P2 for all treatments. These differences were expected and were due to physiological growth and development of the layers as older layers eat more and lay bigger eggs (Anon. 1999; 2000; 2001). The periods between 24–36 weeks are the peak egg production phase or plateau phase for egg production (%) and total egg produced and differences between periods were not expected. The non-significant differences ($p > 0.05$) in FCR between P1 and P2 are also due to the birds entering a consistent phase of peak egg production (Anon. 1999; 2000; 2001).

The non-significant differences ($p > 0.05$) in daily bird ME and CP intake between the Cr treatment groups and the control in P1 and P2 reflected the consistent feed intake data reported earlier. The non-significant differences ($p > 0.05$) between the control and the supplemented groups for ME intake/kg egg in P1 and P2 suggested that Cr supplementation did not improve ME utilisation. The significantly lower ($p < 0.05$) intakes of ME and CP/kg egg in T4 compared to T3 suggested that birds fed organic Cr at the 400 ppb level utilised ME and CP better than those fed higher levels of inorganic Cr. Inorganic Cr supplementation in T3 thus resulted in lower efficiency. Therefore, significantly higher ($p < 0.05$) ME and CP intake were needed to produce a kilogramme of egg compared to birds in T4.

There were significant differences ($p < 0.05$) for daily bird ME and CP intake between P1 and P2 for all treatments. These differences as explained earlier were expected and were due to physiological growth and development of the layers (Anon. 1999; 2000; 2001). The non-significant differences ($p > 0.05$) for ME and CP intake/kg egg between P1 and P2 for all treatments suggested similar efficiencies in utilising ME and CP to produce a kilogramme of eggs during these periods. This is in contrast to the report of Sahin, Sahin and Kucuk (2002) who showed that digestion of nutrients improved with Cr picolinate supplementation and hence better efficiencies in energy and protein utilization were obtained.

The non-significant differences ($p > 0.05$) in mean fat content (g/egg) between treatments in P1 suggested that the treatments had no effect over the initial 6 weeks period. Extending the supplementation period by another 6 weeks, significantly lower ($p < 0.05$) egg fat content in T4 compared to the control (T1) suggesting that 400 ppb Cr-yeast could decrease total egg fat. The non-significant differences ($p > 0.05$) observed between treatments in MUFA and PUFA contents suggested that the Cr treatments had no effect on MUFA and PUFA contents.

The non-significant differences ($p > 0.05$) in saturated fat content (%/egg) between treatments in P1 suggest that the treatments had no effect over the initial 6 weeks period. However in P2, the significantly lower ($p < 0.05$) egg saturated fat content in T3, T4 and T5 compared to the control suggested that inorganic Cr (800 ppb) and organic Cr (400 and 800 ppb)
supplementation could reduce egg saturated fat when fed over a long period.

Supplementation with 400 ppb organic Cr could significantly improve mean and total egg weights and reduce fat and saturated fat content when fed up to 12 weeks, but no significant improvements were observed for FCR. It should be noted that the period of feeding of up to 12 weeks could be considered too long and might be uneconomical in a commercial enterprise. Cheaper inorganic Cr (800 ppb) supplements could however be considered to reduce saturated fat content with comparable FCR to the control.

Although studies by Jensen and Maurice (1980), Nakaue and Hu (1997), Hossain (1998) and Lyons (1998) have reported the beneficial effects of Cr on egg cholesterol and egg quality. Other studies (Page et al. 1991; Achee et al. 1992; and Sahin, Onderci, et al. 2002) have not reported similar observations. The past decade has seen joint laboratory and entrepreneurial efforts to produce and market new nutraceutical or ‘designer’ eggs with specific nutritional characteristics (Wong 1997; Lyons 1998; Sim 1998; Wong and Tan 2003) to support or enhance key aspects of human health. The ability to change egg composition in terms of contributing towards improved consumer health is thus of relevance to the egg industry today in that consumers are willing to pay a premium for specialty food products that have enhanced nutritional value.

Conclusion
Chromium supplementation could be a useful method for modifying the nutritional profile of the egg and may also offer protective management practice in preventing heat stress-related depression in the performance of laying hens. Further studies are however needed to determine the type of Cr supplements and optimal levels of inclusion in the feed.

References


serum cholesterol, egg production, egg cholesterol and egg quality of laying hens. 

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Sahin, K., Onderci, M., Sahin, N. and Aydin, S. (2002). Effects of dietary chromium picolinate and ascorbic acid supplementation on egg production, egg quality and some serum metabolites of laying hens reared under a low ambient temperature (6 degrees C). *Arch Tierernahr* 56*(1):* 41–9


Abstrak

Kesan makanan tambahan kromium (Cr) klorida dan Yis-Cr terhadap pengambilan makanan, pengeluaran telur dan kandungan asid lemak di dalam telur dikaji sepanjang 2 tempoh (T1 = Umur ayam 25–30 minggu, T2 = Umur ayam 31–36 minggu). Ayam penelur baka Lohmann warna coklat diberi makan rangsum mengikut perlakuan yang berikut: P1 = Diet kawalan, P2 = Diet kawalan ditambah 400 ppb Cr dari CrCl₃.6H₂O, P3 = Diet kawalan ditambah 800 ppb Cr dari CrCl₃.6H₂O, P4 = Diet kawalan ditambah 400 ppb Cr dari Yis-Cr dan P5 = Diet kawalan ditambah 800 ppb Cr dari Yis-Cr.

Pengambilan makanan, pengeluaran telur, bilangan telur dan kecekapan penukaran makanan tidak berbeza secara ketara (p >0.05) antara perlakuan. Perbezaan secara ketara (p <0.05) antara P4 dan kawalan dilihat pada purata dan jumlah berat telur dalam kajian T2 sahaja. Pengambilan ME harian, pengambilan ME/kg telur, pengambilan protein kasar dan pengambilan protein kasar/kg telur tidak berbeza secara ketara (p >0.05) antara perlakuan dalam kajian T1 dan T2. Perbezaan secara ketara (p <0.05) antara kajian T1 dan T2 dilihat pada pengambilan harian ME dan protein kasar bagi semua perlakuan. Perbezaan secara ketara (p <0.05) antara kajian T1 dan T2 juga dilihat pada pengambilan ME dan protein kasar/kg telur bagi P5 sahaja.

Kandungan lemak telur tidak berbeza secara ketara (p >0.05) antara perlakuan dalam kajian T1, manakala pada T2, kandungan lemak telur bagi P4 lebih rendah dan berbeza secara ketara (p <0.05) daripada perlakuan kawalan. Kandungan MUFA dan PUFA di dalam telur pada kajian T1 dan T2 tidak berbeza secara ketara (p >0.05) antara perlakuan. Pada kajian T1, kandungan lemak tepu juga tidak berbeza secara ketara (p >0.05) antara perlakuan, manakala pada kajian T2, kandungan lemak tepu pada P3, P4 dan P5 adalah lebih rendah dan berbeza secara ketara (p <0.05) daripada perlakuan kawalan. Penambahan Cr organik dan tak organik tidak berkesan meningkatkan pengeluaran telur, kecekapan penukaran makanan dan penggunaan nutrien. Walau bagaimanapun, penambahan Cr organik dapat meningkatkan mutu telur melalui pengurangan jumlah lemak dan lemak tepu telur.