Sensory evaluation of eggs produced by laying hens fed diet containing flaxseed and thymus meal

Einfluss von Leinsaat und Thymian im Legehennenfutter auf die sensorischen Eigenschaften von Eiern

Angela S. Tserveni-Gousi

Introduction

The benefits of the polyunsaturated fatty acids (PUFA) for human health in general, and the short and long chain ω-3 PUFA linoleic acid (LNA), eicosapentaenoic acid (EPA), and docosahexaenoic acid (DHA) in particular, indicate that their presence in diet should be increased (NEWTON, 1996; BOTSOGLOU et al., 1998; LOPEZ-BOTE et al., 1998).

However, the ingredients used in layer feeds to enrich eggs with PUFA often influence the sensory characteristics of the eggs (HARGIS and VAN ELSWYK, 1993). As the polyunsaturated lipids oxidize, they form hydroperoxides, which are susceptible to further oxidation or decomposition to secondary reaction products such as short-chain aldehydes, ketones, and other oxygenated compounds that may adversely affect flavor, taste, nutritional value, and overall quality of foods (VERCELLOTTI et al., 1992). So, care has to be taken when designing n-3 fatty acid-rich poultry rations to assure that the resulting egg fatty acid profile is useful for promoting consumer health and for maintaining egg sensory quality (VAN ELSWYK, 1997).

Odor and flavor in eggs are important both aesthetically and physiologically as they stimulate the secretion of digestive juices. A major problem in using fish oil or menhaden meal in layer diet is the risk of fishy taste and off-flavor in the egg (KOEHLER and BEARSE, 1975; NASH et al., 1996). Poultry rations containing flaxseed can increase levels of omega-3 fatty acids in egg yolks and improve the omega-6/omega-3 fatty acid ratio; however, in sensory evaluations, panelists detected a fishy or off-flavor in the egg (KOHHLER and BEARSE, 1975; NASH et al., 1995). As the ω-3 fatty acid content of egg yolk may increase consumer acceptance of egg products if eggs maintain their characteristic functionality, exhibit compositional stability, and are sensorial acceptable. Also, according to the findings of SCHEIDELER et al. (1994) the overall acceptability of eggs from flax-fed hens was not greatly different from that of regular eggs. Enriched chicken eggs with DHA (VAN ELSWYK et al., 1995) and LNA (CASTON et al., 1994; AHN et al., 1995) sometimes show different sensory characteristics.

There is currently a great worldwide interest in finding new and safe antioxidants from natural sources to prevent oxidative deterioration of foods and to minimize the risk of oxidative damage of living cells (NAKATANI, 1992). Thyme is a plant containing compounds that possess natural antioxidant activity (PRATT, 1992; BOTSOGLOU et al., 1997). Studies on the composition of antioxidant constituents in thyme leaves have shown that thymol, carvacrol and other phenolics such as p-cymene-2,3-diol (2,3-dihydroxy-4-isopropyl-1-methylbenzene) and several biflhenic and flavonoid compounds also exhibit antioxidant activity (MIURA and NAKATANI, 1989). According to the investigations of SCHWARZ et al. (1996), the phenolic component (p-cymene-2,3-diol) of thyme, especially of Thymus vulgaris L., exhibited the strongest antioxidant activity which was greater than that of alpha-tocopherol and butylated hydroxyanisole. However, little is known concerning the effect of thyme on the sensory characteristics of the eggs.

The objectives of the trial reported here were to test the effects of whole flaxseed at dietary levels of 5%, 10% or 10% plus thymus meal compared to a corn-soybean control on sensoric parameters of eggs.

Materials and methods

Thirty six Lohman laying hens, 42 weeks of age were randomly distributed in 12 pens with 3 birds per pen. The birds were allotted to four dietary treatments which included a typical corn-soybean-based layer ration that served as a control diet (A), and three rations enriched with 5% whole flaxseed (B), 10% whole flaxseed (C) or 10% whole flaxseed + 2% thymus meal (Gr 1002989-No of the greek patent for a method of omega-3 egg production) (D). In all three rations 50 IU vitamin E/kg of feed was added. Diets were formulated to meet the daily requirements of the laying hen at 90% egg production according to NRC (1994) recommendations (crude protein 16.5%, fat 3.0%, fibre 4.5%, M.E. 2800 Kcal/kg), stored in airtight opaque containers, and given to hens ad libitum throughout the experiment which lasted 10 weeks. The fatty acid profile of the used flaxseed (% of total fatty acids), as determined by the gas chromatography method, was as follows: C16:3(9,10,12) 56.95%, C18:2(9,12) 14.56%, C18:3 9.83%, C20:4 18.65%.

At the hen age of 47 weeks (5 weeks after the beginning of the experiment) and for the following 4 weeks, 200 eggs per week (50 from control and 50 from dietary treatment) were collected for egg quality assessment (egg weight – nearest 0.1 g; specific gravity-by Archimedes method; yolk and albumen weight – nearest 0.1 g; Haugh units – by E.Q. Instrument-Technical Services and Supplies Ltd, Top.

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Lane Copmanthorpe, York, UK; yolk color — by Roche fan, 1993 date of release).

A sample of 20 eggs per dietary treatment was used for the determination of the yolk fatty acid composition (for each dietary treatment all yolk quantities were pooled) using the gas chromatography method as described by Botsoglou et al. (1998).

In the 48th and 51st week of age and during two subsequent days (Monday and Tuesday) for each week, 48 eggs (12 per treatment) were used for the sensory evaluation (panel test). The eggs were collected the day before cooking and held overnight at 10 °C. On the next day the eggs were brought up to room temperature prior to cooking by boiling water method (Irmiter et al., 1970). Hard cooked eggs were equilibrated to room temperature when served to a consumer panel.

For this sensory analysis 12 untrained panelists with experience of sensory evaluation (students at the American Farm School), were asked to evaluate peeled eggs by cutting each egg in half and obtaining information on egg odor, egg flavor, presence of any off-flavor, color, and overall acceptability of the egg. Each panelist was presented four eggs, which were assigned with random numbers and allowed to sample in any order.

Evaluations were performed in a purpose-designed room. Panels were instructed to eat unsalted-top crackers, drink water between each sample to clear the palate and pause for 25s between samples. The panels were asked to rank each sensory characteristic on a 9-point hedonic scale for degree of acceptance with 9 = like very much to 1 = dislike very much.

Production parameter data were subjected to analysis of variance as a randomized design with dietary treatments as the main effects and means were compared by least significant difference test. Sensory panel data from both ages were pooled and analysis of variance procedure for the response variables, e.g., egg odor, flavor etc. was used. Response variables with significant differences in variances were further analyzed by Tukey’s test (Statistix for Windows-version 2.0, 1998).

Results and discussion

The results of the yolk quality characteristics are shown in Table 1. Egg and yolk weight were significantly (P < 0.05) influenced by dietary treatment. Dietary supplementation of 10% whole flaxseed + 2% thymus meal resulted in greater egg weight (67.33 g for treatment D vs 63.00, 64.99, 66.10 g for treatment A, B, C, respectively). These findings are not consistent with previous results reporting a weight depression of eggs from hens fed ω-3 fatty acids (Marshall et al., 1994; Oh et al., 1994; Scheideler and Froning, 1996) but are in agreement with those of Yannakopulos et al. (1997) who reported that dietary flaxseed increased egg weight. It should be noted that no differences in egg quality characteristics were found between groups at the beginning of the experiment (hen age 42 weeks).

Yolk weight, following a pattern similar to egg weight, was significantly (P < 0.05) increased by flaxseed feeding, especially for the treatments with the higher flaxseed level (C and D vs A and B). Scheideler and Froning (1996) found a consistent effect of flaxseed on decreasing yolk size (1 to 2 g reductions in yolk weight after feeding 5% or 15% ground or whole flaxseed).

Albumen weight, Haugh units and specific gravity were similar (P > 0.05) between dietary treatments. Jiang et al. (1991) found no effect of flaxseed on egg specific gravity. Also, Scheideler et al. (1994) reported that egg Haugh units were not significantly affected by dietary treatments (control; fish oil; and 5, 10, or 15% whole or ground flaxseed).

Yolk color was influenced by dietary treatment; dietary supplementation of 10% whole flaxseed resulted in lighter (P < 0.05) yolk color (11.50 for treatment C vs 12.12, 12.00, 12.30 for treatment A, B, D, respectively). Leeson et al. (1998) found that eggs from birds fed 10 or 20% flaxseed had paler colored yolks, due to the lower content of xanthophyll pigments in the diets, whereas Jiang et al. (1992) indicated a darkening of yolks from hens fed 15% flaxseed. According to our results, when 10% flaxseed was combined with thymus meal (treatment D) the yolk color was not influenced by flaxseed supplementation.

The yolk fatty acid composition presented in Table 2 shows that high levels of omega-3 fatty acids were incorporated in eggs following the level of flaxseed in feed. These alterations in yolk composition resulted in a decrease in the ratio of omega-6 (LA): omega-3 fatty acids for 5, 10, and 15% flaxseed diets. According to the findings of Scheideler and Froning (1996) incorporation of linoleic acid (C18:3 ω-6) into the egg increased linearly as the level of dietary flaxseed increased (2.31, 4.18, or 6.83% of the yolk fatty acids for 5, 10, and 15% flaxseed diets, respectively). Furthermore, according to the findings of van Elswyk (1997) and Scheideler et al. (1998) the distribution of the omega-3 PUFA in egg yolk lipid classes varied between hen strains. The results of the sensory evaluation of eggs are shown in Table 3. The highest ratings for egg odor, fla-

| Table 1. Egg quality characteristics between dietary treatment
<table>
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<tbody>
<tr>
<td>Dietary treatment</td>
<td>Egg weight (g)</td>
<td>Albumen weight (g)</td>
<td>Yolk weight (g)</td>
<td>Yolk color</td>
</tr>
<tr>
<td>A (0% flaxseed — control)</td>
<td>63.00</td>
<td>40.00</td>
<td>15.90</td>
<td>12.12</td>
</tr>
<tr>
<td>B (5% whole flaxseed)</td>
<td>64.00</td>
<td>40.10</td>
<td>16.65</td>
<td>12.00</td>
</tr>
<tr>
<td>C (10% whole flaxseed)</td>
<td>66.10</td>
<td>40.30</td>
<td>18.10</td>
<td>11.50</td>
</tr>
<tr>
<td>D (10% whole flaxseed + thymus meal)</td>
<td>67.33</td>
<td>41.10</td>
<td>18.30</td>
<td>12.30</td>
</tr>
</tbody>
</table>

P value (ANOVA) 0.03 0.34 0.003 0.04 0.42 0.24
Se of comparison 0.80 2.05 0.60 0.21 5.13 0.06

n = total number 800 egg [200 from control and 200 from each of the rest dietary treatments]
Mean values within a column with no common superscripts differ significantly (P < 0.05)
Table 2. Yolk fatty acid composition (% of the total yolk fatty acids) between dietary treatment  
Fettsäuremuster des Dotter (in % der Gesamtfettsäuren) in Abhängigkeit von der Behandlung  

<table>
<thead>
<tr>
<th>Fatty acid</th>
<th>Dietary treatment&lt;sup&gt;1&lt;/sup&gt;</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>A</td>
</tr>
<tr>
<td>C&lt;sub&gt;18:2&lt;/sub&gt;&lt;sup&gt;(ω-6)&lt;/sup&gt;</td>
<td>15.33</td>
</tr>
<tr>
<td>C&lt;sub&gt;18:3&lt;/sub&gt;&lt;sup&gt;(ω-3)&lt;/sup&gt;</td>
<td>0.89</td>
</tr>
<tr>
<td>C&lt;sub&gt;20:3&lt;/sub&gt;&lt;sup&gt;(ω-3)&lt;/sup&gt;</td>
<td>0.00</td>
</tr>
<tr>
<td>C&lt;sub&gt;22:3&lt;/sub&gt;&lt;sup&gt;(ω-3)&lt;/sup&gt;</td>
<td>0.10</td>
</tr>
<tr>
<td>C&lt;sub&gt;22:6&lt;/sub&gt;&lt;sup&gt;(ω-3)&lt;/sup&gt;</td>
<td>1.30</td>
</tr>
<tr>
<td>Σ&lt;sub&gt;ω-3&lt;/sub&gt;PUFA</td>
<td>2.29</td>
</tr>
<tr>
<td>Σ&lt;sub&gt;ω-6&lt;/sub&gt;PUFA</td>
<td>18.01</td>
</tr>
<tr>
<td>Σ&lt;sub&gt;ω-3ω-6&lt;/sub&gt;</td>
<td>7.86</td>
</tr>
</tbody>
</table>

<sup>1</sup>A (0% flaxseed — control), B (5% whole flaxseed), C (10% whole flaxseed), D (10% whole flaxseed + thymus meal)  

and overall acceptability were given for birds fed 10% whole flaxseed and thymus meal (8.08, 8.00, 8.50 for treatment D vs 7.41, 7.17, 6.75; 7.58, 7.25, 7.50; 7.50, 7.33, 7.58 for treatment A, B, C, respectively). The panelists found the eggs from hens fed the diet supplemented with 10% whole flaxseed and thymus meal to be more acceptable. It should be suggested that the use of 10% whole flaxseed in combination with thymus meal (natural antioxidant and aromatic herb) resulted in an increase of the overall acceptability due to stabilizing the yolk fatty acids and enriching the egg yolk with aromatic phenolic components. 

These data confirm our conclusion that yolk color tested by panelists was not affected by dietary treatment. According to the findings of HUYGHEBAERT (1995) reported that there are no differences in sensory characteristics for eggs laid by hens fed different dietary levels (0, 3, 6 or 9%) and combinations of lard, soybean oil and flaxseed oil. HERBER-McNEIL and VAN ELSWYK (1998) reported that consumer panelists found ω-3 FA eggs enriched with marine algae as acceptable as typical eggs. In addition, SCHEIDELER et al. (1994) found that the overall acceptability of eggs from flaxseed hens was similar to that of eggs from diets enriched with menhaden fish oil and did not greatly differ from that of regular eggs. According to the findings of HAMMERSHOJ (1995), the sensory evaluation of taste of yolk differed by lower grades for eggs from diets with fish oil, although they still have been above the acceptability limit.

The highest score (P < 0.05) for egg odor was recorded for eggs from treatment D involving 10% flaxseed and thymus meal. Flavor was affected (P < 0.05) by dietary treatment being better for eggs from birds whose diet contained flaxseed. LEESON et al. (1998) found that high (>10%) levels of flaxseed used in the bird's diet will result in some decrease in overall egg acceptability as assessed by aroma and flavor and these effects seem to be accentuated by using high (100 IU) levels of vitamin E in the bird's diet. JIANG et al. (1992) reported highly significant increases of LNA feeding 15% flaxseed, but also reported a high incidence (36% of respondents) of a fishy flavor in flax fed chicken eggs assessed by sensory analysis; this fishy flavor was speculated to come from oxidation of the flaxseed oil prior to consumption by the laying hens.

Fishy taint is the most common off-flavor reported in hard-boiled eggs (WAKING, 1982). In our study, the lowest score (4.00) for off-flavor was recorded for eggs from birds whose diet contained 10% flaxseed and thymus meal. This could be due to the addition of thymus meal which contributed to the low score of off-flavors. Our data do not confirm the conclusion of CASTON et al. (1994) that there is an indication of off-flavor in eggs from birds that consume flaxseed. Also, according to the findings of LEESON et al. (1998), off-flavors were detected in eggs from hens fed 10 and 20% flaxseed with 10 mg vitamin E/kg.

Yolk color tested by panelists was not affected (P > 0.05) by dietary treatment. According to the findings of VAN ELSWYK and AYMOND (1994) alterations in yolk color of ω-3 enriched shell eggs produced by flaxseed flocks may limit consumer acceptability; however, although raw yolks were significantly influenced by dietary treatments, no detectable differences in color were noted when yolks from each treatment were cooked. These data confirm our conclusion that yolk color tested by Roche fan (Table 1) was lower (P < 0.05) in treatment C (10% flaxseed), whereas, there were no differences (P > 0.05) between treatments in the sensory analysis (boiled eggs — Table 3).

The results of this study suggest that dietary flaxseed, especially in combination with thymus meal, is useful for enhancing yolk ω-3 fatty acids and consumer acceptability of the resulting egg product. The inclusion of flaxseed in combination with thymus reduces off-flavors and improves odor, flavor and color of boiled eggs.

Table 3. Effects of dietary flaxseed level on sensory analysis of eggs<sup>1</sup>  
Einfuss des Lein gehaltes in der Futtermatir auf die sensorischen Eigenschaften der Eier  

<table>
<thead>
<tr>
<th>Dietary treatment</th>
<th>Odor</th>
<th>Flavor</th>
<th>Off-flavor</th>
<th>Color</th>
<th>Overall acceptability</th>
</tr>
</thead>
<tbody>
<tr>
<td>A (0% flaxseed — control)</td>
<td>7.41&lt;sup&gt;a&lt;/sup&gt;</td>
<td>7.17&lt;sup&gt;a&lt;/sup&gt;</td>
<td>5.42&lt;sup&gt;a&lt;/sup&gt;</td>
<td>7.33</td>
<td>6.75&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>B (5% whole flaxseed)</td>
<td>7.58&lt;sup&gt;a&lt;/sup&gt;</td>
<td>7.25&lt;sup&gt;b&lt;/sup&gt;</td>
<td>5.75&lt;sup&gt;a&lt;/sup&gt;</td>
<td>7.50</td>
<td>7.50&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>C (10% whole flaxseed)</td>
<td>7.50&lt;sup&gt;a&lt;/sup&gt;</td>
<td>7.33&lt;sup&gt;b&lt;/sup&gt;</td>
<td>5.08&lt;sup&gt;b&lt;/sup&gt;</td>
<td>7.08</td>
<td>7.58&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>D (10% whole flaxseed + thymus meal)</td>
<td>8.08&lt;sup&gt;b&lt;/sup&gt;</td>
<td>8.00&lt;sup&gt;b&lt;/sup&gt;</td>
<td>4.00&lt;sup&gt;b&lt;/sup&gt;</td>
<td>7.67</td>
<td>8.50&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

<sup>1</sup>Hedonic scale 1 to 9, with higher number denoting stronger odor, off-flavor, color, or better flavor and overall acceptability.
Acknowledgement

The author appreciates and thanks the American Farm School of Thessaloniki, Greece for the assistance, and Professor A. L. Yannakopoulos for the useful critique of this paper.

Summary

An experiment was undertaken to test the effects of whole flaxseed at dietary levels of 5%, 10% or 10% plus 2% thymus meal compared to a corn-soybean control on the sensory quality of eggs.

Dietary flaxseed increased (P < 0.05) egg weight and yolk weight compared to the control diet. Specific gravity, Haugh units and albumen weight were similar (P > 0.05) between treatments. Eggs from treatment C (10% flaxseed) were paler than those from the other dietary treatments.

Consumer panelists found that n-3 fatty acids enriched eggs are more acceptable than typical eggs. Especially, eggs from hens fed the whole flaxseed diet enriched with thymus meal had the highest scores for odor, flavor, and overall acceptability as well as the lowest score for off-flavor. Yolk color was not affected by dietary treatments. The inclusion of flaxseed in combination with thyme reduces off-flavors and improves odor, flavor and color of boiled eggs.

Keywords

Nutrition, layers, flaxseed, thymus, omega fatty acids, sensory

Zusammenfassung

Einfluss von Leinsaat und Thymian im Legehennenfutter auf die sensorischen Eigenschaften von Eiern

In der vorliegenden Untersuchung wurde der Einfluss von Leinsaat in den Zulagemengen 5%, 10% sowie 10% plus 2% Thymian auf die sensorischen Eigenschaften von Eiern im Vergleich zu einer Mais-Soja-Kontrolle überprüft.

Im Vergleich zur Kontrolle führte der Einsatz von Leinsaat zu signifikant höheren Ei- und Dottergewichten (P < 0.05). Das spezifische Gewicht, die Haugh-Einheiten und das Eiklargewicht waren dagegen zwischen den Behandlungen nicht unterschiedlich (P > 0.05). Die Eischalen aus der Behandlung C (10% Leinsaat) waren heller als die Eischalen aus den übrigen Behandlungen.


Stichworte

Fütterung, Legehene, Leinsaat, Thymian, Omega-Fettsäuren, Sensorik

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