MEDIUM-CHAIN FATTY ACIDS, EMULSIFIERS AND PHYTOBIOTIC FEED ADDITIVES INFLUENCE ON LAYING HEN'S EGGS' SENSORIC QUALITY

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Abstract. The aim of this research was to evaluate how medium-chain fatty acids, emulsifiers and phytobiotic additives in feeds influence sensory quality of laying hen's eggs' – fresh and retained for 28 days. Laying hens were fed standard compound feed which was additionally interspersed with mix of medium-chain fatty acids (MCFA), besides that, feeds were additionally interspersed with emulsifiers (Lipidol, Lysoforte Booster) and phytobiotic feed additive (Sangrovit Extra). Eggs were supplied for sensory analysis fresh and in the end of it's realization (after 28 days of storage at 4°C). Sensory traits evaluated were intensity of egg yolk and albumen attributes, such as overall odor, non typical odor, hardness, taste of yolk or albumen, non-typical taste, yolk color intensity, granularity of yolk. Medium-chain fatty acids, emulsifiers and phytobiotic additives in feeds did not affect the sensory properties of the fresh and stored for 28 days eggs. Visual evaluation of eggs during sensory analysis did not reveal any differences in albumen color homogeneity or yolk color intensity. Selected concentration of feed additives did not alter albumen or yolk taste, odor, or texture. Therefore, the proposed feed additives supplements could be used for laying hens diet as they do not decrease product sensory quality.

Keywords: medium-chain fatty acids**,** emulsifiers', feed additives, eggs sensory analysis

Introduction

The egg is an excellent source of essential fatty acid mainly belonging to the n-6 series (linoleic and arachidonic acids) and also contains moderate amounts of n-3 polyunsaturated fatty acids (PUFA), which are particularly sensitive to oxidative deterioration and potentially responsible for the formation of peroxides and off-flavors, changes of taste, texture and color (Franchini et al., 2002).

Sensory properties are between the most important egg quality criteria. The quality of egg albumen is dependent on numerous factors (Niewiarowicz et al, 1991). Albumin quality is related to the consistency, appearance and the functional properties. Yolk quality is determined by the color, texture, firmness and smell of the yolk. It is possible to manipulate the yolk color of eggs by the addition of natural or synthetic xanthophylls to layer hen feeds. Although yolk color is a key factor in any consumer survey relating to egg quality (Jacob et al., 2000). Other causes of off odors or flavors' include strongly flavored feed ingredients (Coutts and Wilson, 1990). During storage, several physical changes occur in the egg, storage oxidation affect the taste and smell properties of the egg (Leek, 2015).

Sensory properties and chemical composition strongly depends on feed's composition and quality (Zaheer, 2015; Huopalahti et al., 2007) egg storage conditions and egg age (Bozkurt et al., 2012). Some studies that evaluated the use of additives in order to modify the lipid and antioxidant composition of eggs reported alterations in the sensory characteristics (Horsted et al., 2010; Sujatha et al., 2010; Lawlor et al., 2010; Caston et al., 1994). Emulsifiers are often interspersed into feeds as they can improve egg weight, egg yolk color, nutrient digestibility and have beneficial effects on egg production, besides that, they can also influence egg's flavor and odor alterations (Mandalawi et al., 2015, Surech et al., 2014). The stimulatory effect of phytogenic additives on feed intake is due to the maintained improvement in palatability of the diet resulting from the enhanced flavor and odor (Kroismayr A. et al., 2006; Abd et al, 2008).

Many studies have been conducted concerning the effects dietary supplementation of feed additives and storage time on egg quality. However, the interaction of dietary supplementation of feed additives (medium-chain fatty acids, emulsifiers and phytobiotics) storage time on sensory eggs properties is not fully known. Therefore, the aim of this research was to evaluate how medium-chain fatty acids, emulsifiers and phytobiotic additives in feeds influence sensory quality of laying hens eggs'– fresh and retained for 28 days.

Methods and materials

Feeding experiment. The feeding experiment was performed in Institute of Animal Rearing Technologies, Lithuanian University of Health Sciences, Veterinary Academy. The research was carried out complying with the Law of the Republic of Lithuania on Animal Care, Housing and Use" (No. XI–2271) as well as complying with the amended Order of State Food and Veterinary Service "On Approval For Requirements For Housing, Care and Use of Animals for Experimental and Other Scientific Research" (No. B1-872 of 24-09-2015). The trial was performed in accordance with EU Directive 2010/63/EEC and the EC recommendation 2007/526 EC for Animal use and storage for experiments and other purposes.

The feeding experiment was performed for 56 days with 30-week old Lohmann Brown lines combination 63 laying hens. Hens were divided into 7 groups, each with 9 hens. During the experiment, layers were housed in individual cages (40 x 50 cm) with stationary drinkers and feeders, under equal feeding and housing conditions. The laying hens of all groups were fed with standard compound feed (table 1), 125 g/per day each, just experimental layers groups feeds were supplemented of feed additives.

Table 1. **Composition and nutrient content of compound feed (%)**

Components	Composition
Wheat	21.325
Maize	20.000
Soybean meal	20.240
Triticale	16.000
Wheat flour	0.140
Sunflower meal	8.000
Vegetable oil	3.642
Sodium chloride	0.290
Monocalcium phosphate	0,838
Feeding granular limestone	8.655
DL-methionine	0.162
Lignabond	0.400
Pentacid liquid	0.100
Premix for laying hens	0.208
Feed quality indices, 1 kg	
Metabolisable energy, MJ/kg	11.44
Crude protein	17.25
Crude fat	5.40
Crude fiber	3.80
Crude ash	12.35
Calcium	3.44
Phosphorus (total)	0.63
Phosphorus (available)	0.41
Sodium*	0.15
Magnesium	0.1
Potassium	0.77
Chlorine*	0.22
NaCl	0.327
Lysine	0.81
Methionine	0.41
Methionine + cystine	0.71
Tryptophane	0.22
Threonine	0.59

Table 2. **The diets used in the experiment**

Group	Diet
I (control)	Compound feed
II (experimental)	Compound feed+ Medium chain fatty acids (dosage – 1 kg/t feeds)
III(experimental)	Compound feed +Medium chain fatty acids (dosage – 1 kg/t feeds)+Lipidol (dosage 0,5 kg/t)
IV(experimental)	Compound feed +Medium chain fatty acids (dosage – 1 kg/t feeds)+Lipidol (dosage 0,5 kg/t)+ Sangrovit Extra (dosage 60g/t)
V(experimental)	Compound feed+ Medium chain fatty acids (dosage – 1 kg/t feeds)+ Lysoforte Booster Dry (dosage 0,5 kg/t)
VI(experimental)	Compound feed Compound feed+ Medium chain fatty acids (dosage – 1 kg/t feeds)+ Lysoforte Booster Dry (dosage 0,5 kg/t)
VII(experimental)	Compound feed+Sangrovit Extra (dosage 60g/t).

The laying hens feed additives and it's concentrations in diets presented in table 2.

The quality of eggs laid by hens was evaluated at the end of experiment. For this purpose, eggs laid in the last week of experiment, by 9 hens from each group were collected each time, between 9:00 a.m. and 12:00 p.m. Fresh and retained (4°C temperature) for 28 days eggs were supplied for sensory analysis.

Sensory analysis. Sensory analysis was performed in KTU Food Institute, laboratory of sensory science. The samples of eggs for sensory analysis were boiled in water bath for 10 min. Then they were removed from heat, cooled by cold running water to temperature 35 ºC, shelled, cut in half, served to a sensory panel, along with room temperature water, tea and unsalted crackers. Each assessor received sample of yolk and sample of albumen, separately. A sensory panel for the quantitative descriptive analysis consisted of 6 assessors experienced in evaluation of eggs sensory quality. The assessors were selected and trained according to the ISO 8586. A structured numerical scale was used for evaluation of the intensity of each attribute. The left side of scale corresponding to the lowest intensity of attribute was given value of 1, and the right side corresponding to the highest intensity was given value of 9. All sessions were conducted in a climate-controlled sensory analysis laboratory equipped with individual booths. The assessors were instructed to clean the palate with water or tea between evaluations of each sample. The samples were presented to the assessors monadically. A data collection system for automatic acquisition of the assessor scores and data analysis was used (FIZZ, Biosystems, France).

Intensity of egg yolk and albumen attributes, such as overall odor, non typical odor, hardness, taste of yolk or albumen, non-typical taste, yolk color intensity, granularity of yolk was determined. Non typical odor or taste was evaluated as any acceptable or not acceptable odor or taste not typical for hard boiled eggs (Parpinello et al., 2006). On the basis of the profile, it was possible to compare products according to separate characteristics and their intensity and to establish relationships between sensory quality and separate characteristics.

Data analysis. SPSS software, version 15.0 (SPSS, Chicago, IL, USA) was used for statistical analysis. The one – way ANOVA was performed to determine the effect of the laying hens feed composition on the sensory quality of eggs. Results are presented as mean values of at least 10 evaluations.

Results and discussions

Mean values of sensory properties of fresh eggs presented in table 3. Changes in laying hen's diet composition had no significant effect on sensory properties of hard boiled eggs albumen. Results of the present study are in agreement with the findings of previous Parpinello et al., (2006) researches.

Table 3. **Diet effect on average values of intensity of sensory properties of fresh eggs**

Parameter	Group						
	I	II	III	IV	V	VI	VII
Albumen							
Overall odor	8.20	7.70	7.50	7.70	7.60	7.60	7.60
Non-typical odor	1.30	1.40	1.20	1.50	1.40	1.10	1.20
Color homogeneity	7.60	7.30	7.40	7.30	7.40	7.20	7.40
Hardness	6.20	6.20	6.10	6.20	6.30	5.70	6.10
Overall taste	7.00	7.10	7.20	7.20	6.90	7.00	7.30
Nontypical taste	1.30	1.20	1.10	1.40	1.30	1.20	1.00
Acceptability	6.30	6.40	6.30	6.70	6.30	6.90	6.60
Yolk							
Overall odor	6.30	6.20	6.40	6.50	6.50	6.50	6.70
Non-typical odor	1.00	1.10	1.10	1.00	1.00	1.00	1.00
Color intensity	4.70	4.60	5.00	5.00	5.10	4.90	4.90
Hardness	4.70	5.00	4.90	4.60	5.30	5.10	5.30
Granularity	2.20	3.50	2.60	2.40	3.20	3.00	2.50
Overall taste	7.00	7.00	6.90	6.70	6.90	6.70	6.90
Nontypical taste	1.00	1.10	1.10	1.20	1.30	1.30	1.00
Aftertaste	5.40	5.30	5.30	5.50	5.60	5.20	5.50
Acceptability	6.60	6.40	6.40	6.60	6.20	6.60	6.50
*- $P < 0.05$							

Eggs color plays a very important role in our perception of food (Bavškova et al., 2014). Visual evaluation of eggs during sensory analysis did not reveal any significant differences in albumen color homogeneity or yolk color intensity.

The results for the inclusion of the phytoboptic additive Sangrovit (group VII) showed that no significant differences were observed in egg (yolk and albumen) odor between control (I) and treatment groups (VII) ($p > 0.05$) also the panelists didn't observed significant differences of overall odor, non-typical odor in albumen and yolk of fresh eggs in II-VI groups. Our results matches with Papa Spada et al, (2016) obtained data, besides that with Beaze et al., (2015) and Parpinello et al., (2006) research data.

Emulsifier‘s additive in layer‘s feeds (III; IV, V, VI groups) had not significant influence on egg‘s albumen and yolk sensory quality, comparing to control group, these results matches with Surech et al., (2014) obtained data, which claims that sensory quality of hard-boiled egg yolk were not affected by the emulsifier enrichment in the feed.

Table 4. **Diet effect on average values of intensity of sensory properties of stored 28 d. eggs**

Parameter	Group						
	I	II	III	IV	V	VI	VII
Albumen							
Overall odour	7.38	6.88	6.50	6.75	6.63	6.63	6.63
Non-typical odour	1.50	1.63	1.13	1.50	1.13	1.38	1.50
Colour homogeneity	7.13	7.00	7.25	7.00	7.13	7.13	6.88
Hardness	6.25	6.25	6.38	6.63	6.75	6.25	6.50
Overall taste	6.63	6.63	6.38	6.25	6.88	6.50	6.75
Nontypical taste	1.50	1.50	1.13	1.50	1.38	1.13	1.25
Acceptability	5.75	5.88	6.00	5.88	6.25	6.13	5.88
Yolk							
Overall odour	6.13	6.00	6.00	5.88	5.88	6.00	6.00
Non-typical odour	1.00	1.00	1.00	1.00	1.13	1.00	1.00
Colour intensity	4.25	4.38	4.38	4.38	4.25	4.63	4.38
Hardness	4.63	4.75	4.88	4.50	5.00	4.75	4.75
Granularity	2.13	3.00	2.63	2.75	3.25	3.00	2.63
Overall taste	6.50	6.25	6.38	6.50	6.13	6.25	6.25
Nontypical taste	1.25	1.50	1.75	1.38	1.75	1.75	1.63
Aftertaste	5.13	5.00	5.13	5.13	5.25	5.50	5.75
Acceptability	5.75	5.75	5.88	5.63	5.38	5.38	5.13
*- $P < 0.05$							

Egg‘s storage for 28 days, according to feed additives used in laying hen‘s feeding, had not influence on egg‘s albumen sensory qualities (table 4), as differences between groups were statistically unreliable. Changes in non typical or overall odor of albumen and yolk wasn’t significant in groups with medium chain fatty acids additives (II, III, IV, V, VII), the results of this study are in accordance with the conclusion of Marshall el al., (1994) research.

Addition of different feed additives resulted in decreased yolk acceptability of IV, V, VI, VII groups compared to the control, but deference’s weren‘t significant ($p>0.05$) which were in line with the findings of Valavan et al. (2013). So different feed additives can be used in lying hens diets without deteriorating egg sensory qualities, these results matches with Hayat et al., (2014) research data.

Conclusions

Feeding laying hens with the diet supplemented with medium chain fatty acids, emulsifiers and phytobiotic did not impair egg sensory quality indices. Medium-chain fatty acids, emulsifiers and phytobiotic additives in feeds for laying hens did not affect the sensory properties of the fresh and stored for 28 days eggs. Selected concentration of feed additives did not alter albumen and yolk taste, odor, or texture. Therefore, the proposed feed additives could be used for laying hens diet as they do not decrease product sensory quality.

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