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Effect of dietary supplementation of lysophospholipids on productive performance, nutrient digestibility and carcass quality traits of broiler chickens

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ABSTRACT

An experiment was carried out to evaluate productive performance, nutrient digestibility and carcass quality traits of broiler chickens fed diets supplemented with an exogenous emulsifier based on lysophospholipids prepared by enzymatic conversion of soy lecithin. One thousand seven-hundred and fifty-five one-day-old male Ross 308 chicks were randomly divided into three experimental groups of nine replications each: control group (CON) fed a corn–soybean basal diet, and two groups fed CON diet supplemented with constant (1 kg/ton) or variable (1–1.5 kg/ton) level of emulsifier (CONST and VARI, respectively). At the end of the trial (42 d), birds receiving the emulsifier had a statistically significant ($p < 0.05$) lower feed conversion rate compared to the control. Body weight and daily weight gain were only slightly influenced by lysophospholipids supplementation, while mortality and feed intake resulted similar among the groups. No statistically significant effect of the emulsifier was observed on nutrient digestibility as well as slaughtering yields, skin pigmentation and incidence of foot pad dermatitis. The results obtained in this study suggest that the use of an emulsifier based on lysophospholipids improves feed efficiency while showed limited effect on carcass quality traits.

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Broiler; carcass quality; digestibility; emulsifier; productive performance

Introduction

Lipids are water-insoluble compounds and their digestion is due to the synergic action of bile salts and pancreatic lipase. Since lipids digestion takes place in an aqueous environment in small intestine, bile salts ensure emulsification of dietary fats allowing pancreatic lipase to hydrolyse the triglycerides present on water–oil interface, with production of 2-monoglycerides and free fatty acids (Leeson & Summers 2001). Furthermore, bile salts play a key role in the formation of mixed micelles which are subsequently absorbed by the mucosa cells in the small intestine (Krogdahl 1985). Hybrid chickens used in intensive broiler production require an adequate dietary source of energy and protein to express their genetic potential. In order to achieve these requirements, great amounts of animal fats and vegetable oils are usually added to broiler diets to increase their energy content (Blanch et al. 1996). However, several factors can affect lipids digestion, both related to the animal characteristics such as bird age (Krogdahl 1985; Tancharoenrat et al. 2013), genetic strain (Katongole & March 1980), secretion and

activity of digestive enzymes (Nitsan et al. 1991; Nir et al. 1993; Noy & Sklan 1995), microflora status (Maisonier et al. 2003), and to the diet composition such as type of fat used as lipid supplement (Tancharoenrat et al. 2014), ratio of unsaturated to saturated fatty acids in the diet (Ketels & De Groote 1989), presence of pentosans (Choct & Annison 1992) and dietary fibre (Jiménez-Moreno et al. 2009). Therefore, given the considerable amount of lipids in broiler diet, the use of exogenous emulsifiers may support bile salts in both emulsion and micelle formation process, determining a positive effect on lipids digestibility and productive performance. Lysophospholipids are mono-acyl derivatives of phospholipids resulting from the action of phospholipase A1 or A2, which hydrolyse respectively the ester bond at sn-1 and sn-2 position (Joshi et al. 2006). Presenting a single fatty acid, these compounds are characterised by higher hydrophilic–lipophilic balance and thus a better oil–water emulsification capacity than the corresponding phospholipids (Schwarzer & Adams 1996). Lysophospholipids show a lower critical micelle

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concentration than bile salts and lecithin (Zubay 1983) and form smaller micelles compared to phospholipids (Mine et al. 1993). On the other hand, lysophospholipids are mentioned to improve gut permeability to macromolecules like proteins and dextrans (Tagesson et al. 1985), regulate the activity of several enzymes (Shier et al. 1976; Tagesson et al. 1985), influence the formation of protein channels (Lundbaek & Andersen 1994) and cause epithelial cells hypertrophy in broiler duodenum (Khonyoung et al. 2015). Despite some studies report the positive or partially positive effects of lysophospholipids in broilers (Schwarzer & Adams 1996; Melegy et al. 2010; Zhang et al. 2011; Jansen et al. 2015), pigs (Dierick & Decuypere 2004; Zhao et al. 2015) and veal calves (Sabbioni et al. 1997), the data found in literature do not allow to obtain a clear indication about their efficacy, due to the different composition of the basal diet used. Furthermore there are no indications concerning the needs to adapt the level of inclusion of lysophospholipids according to the increasing fat content of diets in the different feeding phases.

Therefore, a trial was conducted to evaluate the effects of lysophospholipids prepared by enzymatic conversion of soy lecithin supplemented either at a constant dose or at variable one according to the lipid content of the diets, on productive performance, nutrient digestibility and carcass quality traits of broiler chickens.

Materials and methods

Birds and poultry house

One thousand seven hundred and fifty-five one-day-old male Ross 308 chicks were weighed, randomly divided into three groups and distributed in 27 pens of 6 m² each (65 birds/pen, 11 birds/m²). Each group was composed of nine replications, for a total of 585 birds *per* group. The distribution of pens inside the poultry house was done in randomised blocks in order to minimise any environmental effects. Each pen was equipped with 10 nipples and two circular pan feeders to ensure at least 2 cm/bird of front space. The pen floor was covered with chopped straw (2 kg/m²) and the environment was conditioned and equipped with artificial light. Birds received 23L:1D from 0 to 7 d and for the last 3 days of life, and 18L:6D for the remaining days (European Commission 2007).

Diets

The feeding program was composed of four phases: starter (from 0 to 12 d), grower I (from 13 to 26 d),

grower II (from 27 to 36 d) and finisher (from 37 to 42 d). A common corn–soybean basal diet (Table 1) has been used to prepare the experimental diets. The basal diet was supplemented either with a constant amount (1 kg/ton) of an emulsifier (Lipidol Ultra, Andres Pinaluba, Spain, containing 6% of a standardised mixtures of lysophosphatidylcholine, lysophosphatidylethanolamine, lysophosphatidylinositol and lysophosphatidic acid) from 0 to 42 d (CONST) or increasing amounts of it depending on the level of dietary lipids (1 kg/ton from 0 to 26 d and 1.5 kg/ton from 27 to 42 d; VARI). Control diet (CON) was represented by the basal diet without emulsifier addition.

At the beginning of every feeding phase, feeds were weighed and stocked in an individual and clearly labelled bin provided for each pen. Feed was manually distributed from the bin to the feeders two times a day. Water and feed were provided for *ad libitum* consumption.

Productive performance

At housing and at the end of each feeding phase (12, 26, 36, 42 d), number and weight of birds present in each pen were recorded, as well as the weight of residual feed. Number, age and weight of birds died during the trial were recorded in order to calculate the mortality percentage. On the basis of these measurements, daily weight gain, feed intake and feed conversion rate and cumulative feed conversion rate were calculated on a pen basis and corrected for mortality.

Apparent digestibility

From 19 to 23 d of trial, faecal samples from each box (nine per group for a total of 27 boxes) were collected to evaluate the apparent digestibility of dry matter, crude fat and crude protein. Titanium dioxide, added to both the grower I and grower II diets (3 kg/ton), was used as indigestible marker to evaluate nutrient digestibility. Litter was covered by a plastic sheet to avoid the contact between faeces and the underlying materials. Faeces were collected with care twice a day (morning and afternoon), put in a plastic container and extraneous materials were carefully removed. Samples were mixed in order to obtain a homogeneous pool *per* pen/day and subsequently frozen at –20°C. Proximate analysis was conducted on both feed and faecal samples to evaluate the content of dry matter, crude fat and crude protein. Moisture was determined in duplicate according to the Association of Official Analytical Chemists procedure (AOAC 1990). Crude protein were determined by the standard Kjeldahl copper

Table 1. Ingredients and composition of basal diet.

	Starter (0–12 d)	Grower I (13–26 d)	Grower II (27–36 d)	Finisher (37–42 d)
Ingredients, g/100 g				
Corn	32.22	37.10	37.62	40.89
Wheat	15.00	15.00	15.00	15.00
Sorghum	5.00	5.00	5.00	5.00
Soybean oil	2.53	2.51	3.43	3.61
Soybean meal	21.93	18.73	14.73	11.55
Expanded soybean	10.00	10.00	15.00	15.00
Pea	3.00	3.00	3.00	3.00
Sunflower	3.00	3.00	3.00	3.00
Corn gluten	3.00	2.00	0.00	0.00
Lysine sulphate	0.57	0.53	0.40	0.37
DL-methionine	0.29	0.31	0.33	0.30
L-threonine	0.12	0.11	0.09	0.07
Calcium carbonate	0.57	0.52	0.55	0.56
Dicalcium phosphate	1.40	0.93	0.61	0.51
Sodium chloride	0.33	0.29	0.27	0.19
Sodium bicarbonate	0.00	0.05	0.08	0.18
Premix vit.-min. ¹	0.44	0.38	0.34	0.24
Choline	0.10	0.10	0.10	0.06
Enzymes	0.18	0.18	0.18	0.18
Phytase	0.10	0.10	0.10	0.10
Butyric acid	0.20	0.15	0.00	0.00
Xanthophylls	0.00	0.00	0.18	0.17
Proximate composition				
Dry matter, %	88.42	88.19	87.95	87.97
Crude protein, %	22.52	20.69	19.23	17.92
Total lipid, %	6.34	6.40	8.09	8.35
Crude fiber, %	3.02	2.97	3.01	2.96
Ash, %	5.37	4.74	4.43	4.19
Lysine, %	1.38	1.27	1.18	1.08
Met.+Cyst., %	0.99	0.93	0.87	0.81
Ca (total), %	0.82	0.66	0.58	0.53
P (total), %	0.62	0.53	0.47	0.44
AME, kcal/kg	3050	3100	3200	3250

¹Provided the following per kg of diet: vitamin A (retinyl acetate), 13,000 U; vitamin D3 (cholecalciferol), 4000 U; vitamin E (DL- α -tocopheryl acetate), 80 U; vitamin K (menadione sodium bisulfite), 3 mg; riboflavin, 6.0 mg; pantothenic acid, 6.0 mg; niacin, 20 mg; pyridoxine, 2 mg; folic acid, 0.5 mg; biotin, 0.10 mg; thiamine, 2.5 mg; vitamin B₁₂ 20 μ g; Mn, 100 mg; Zn, 85 mg; Fe, 30 mg; Cu, 10 mg; I, 1.5 mg; Se, 0.2 mg; ethoxyquin, 100 mg.
AME: apparent metabolizable energy.

catalyst method as described in AOAC (1990). Crude fat were determined using the Soxhlet method (AOAC 1990), which allows to extract the ethyl-ether soluble substances present in the sample. The amount of titanium dioxide was determined by a spectrophotometric analysis, according to the procedure proposed by Myers et al. (2004). Briefly, a sample of 1 g either of feed or faeces was put in a glass tube with 13 ml of H₂SO₄ 96% (CAS: 7664-93-9, EC: 231-639-5, Carlo Erba Reagents s.r.l., Milano, Italy), 3.5 g of K₂SO₄ and 0.4 g of CuSO₄. Samples were digested in a macro-Kjeldahl apparatus (Gerhardt Kjeldatherm) for 2 h at 420 °C. Subsequently, 10 ml of H₂O₂ 30% (CAS: 7722-84-1, EC: 231-765-0, Carlo Erba Reagents s.r.l., Milano, Italy) and distilled water were added and the liquid was filtered to remove the precipitate. The aqueous phase was read at 410 nm with an UV/Vis Spectrophotometer (Jasco model 7800). A standard curve has been previously prepared using solutions containing 0, 2, 4, 6, 8 and 10 mg of TiO₂ to calibrate the spectrophotometer. Finally, the amount of titanium dioxide detected was used to assess the apparent digestibility of the

nutritional components according to the following formula, obtained by a modification of those used by Kluth & Rodehutsord (2006):

$$\text{Apparent digestibility (\%)} = \left\{ \frac{\text{TiO}_2 \text{ feed}}{\text{TiO}_2 \text{ faeces}} \times \frac{\text{Nutrient faeces}}{\text{Nutrient feed}} \right\} \times 100$$

where *TiO₂ feed* and *TiO₂ faeces* are the respective concentration of titanium dioxide detected in feed and faeces, while *nutrient feed* and *nutrient faeces* represent the quantity of the specific nutrient (dry matter, crude protein, crude fat) respectively in feed and faeces.

Carcass traits

At the end of the trial (42 d), broilers were subjected to a total feed withdrawal of 12 h and slaughtered in a commercial slaughterhouse. Eviscerated yield, as well as the percentage of breast, legs and unseparated wings, was measured on all the slaughtered birds. During the slaughtering process, a foot of each birds

was collected and subjected to a macroscopic analysis to evaluate the incidence of foot pad lesions, scored in three classes according to the method proposed by Ekstrand et al. (1998): 0 = no lesion, 1 = mild lesion (<0.8 cm), 2 = severe lesion (>0.8 cm). Moreover, lesion score was calculated according to the formula in the Commission of the European Communities (2005). The number of feet in class 0 did not contribute to the score, while the number of feet in class 1 was multiplied by 0.5 and the number in class 2 was multiplied by 2. Finally, the scores were added and the total was divided by the sample size and multiplied by 100.

Skin pigmentation was measured 24-h *postmortem* in 280 randomly selected carcasses per experimental group. The CIE (1978) system colour profile of lightness (L*), redness (a*) and yellowness (b*) was detected by a reflectance colorimeter (Minolta Chroma Meter CR-300, Minolta Italia S.p.a, Milano, Italy) using illuminant source C. A standard white ceramic tile was used to calibrate the colorimeter throughout the study and colour was measured in triplicate on the ventral pterygiae.

Statistical analysis

The data were analysed using a one-way ANOVA, considering the dietary inclusion of the emulsifier as the independent variable. Means were separated by Student Newman-Keuls test using SAS statistical package (SAS 1988). Prior to analysis, mortality data were submitted to arcsine transformation. Moreover, the data regarding the frequency distribution of foot pad lesions were analysed using chi-square test. Differences were considered statistically significant at $p \leq 0.05$ level.

Results and discussion

Productive performance

The effects of the emulsifier on productive performance are shown in Table 2. The addition of the emulsifier does not statistically improve final body weight (2617 vs. 2643 vs. 2643 g, respectively for CON, CONST and VARI groups) and daily weight gain of broilers (61.3 vs. 61.9 vs. 61.9 g/bird/d, respectively for CON, CONST and VARI groups). These observations are partially in contrast with Melegy et al. (2010) who reported that the use of an emulsifier based on lysolecithin at the dosage of 0.25 or 0.5 kg/ton of feed significantly improves these productive parameters.

The emulsifier does not affect the feed intake as birds consumed a similar daily amount of feed (116.7

Table 2. Productive performance of CON, CONST and VARI groups in each feeding phase and in the whole period of trial (0–42 d).

	Treatments				Probability
	CON	CONST	VARI	SE	
No. replications	9	9	9		
Body weight, g/bird					
0	41.1	41.5	41.4	0.14	ns
12	300.0	303.5	303.8	3.02	ns
26	1115	1129	1121	10.91	ns
36	2012	2029	2028	15.17	ns
42	2617	2643	2643	16.46	ns
Daily weight gain, g/bird/d					
0–12	21.6	21.8	21.9	0.26	ns
13–26	58.2	59.0	58.4	0.72	ns
27–36	89.5	90.0	90.4	1.06	ns
37–42	100.1	102.3	102.5	1.23	ns
0–42	61.3	61.9	61.9	0.36	ns
Feed intake, g/bird/d					
0–12	34.1	34.5	33.8	0.52	ns
13–26	104.0	103.7	102.0	0.92	ns
27–36	180.4	177.7	178.6	1.01	ns
37–42	207.6	205.8	207.6	1.00	ns
0–42	116.7	116.0	115.5	0.41	ns
Feed conversion rate					
0–12	1.583	1.579	1.541	0.02	ns
13–26	1.791	1.759	1.745	0.02	ns
27–36	2.019	1.976	1.979	0.02	ns
37–42	2.077	2.013	2.029	0.02	ns
0–42	1.913 ^a	1.875 ^b	1.871 ^b	0.01	<0.05
Mortality, %					
0–12	0.17	0.00	0.19	0.01 ^c	ns
13–26	0.34	0.34	0.39	0.02 ^c	ns
27–36	0.52	0.00	0.58	0.02 ^c	ns
37–42	0.34	0.00	0.00	0.01 ^c	ns
0–42	1.37	0.34	1.16	0.03 ^c	ns

CON: control diet; CONST: control diet +1 kg/ton of lysophospholipids emulsifier; VARI: control diet +1–1.5 kg/ton of lysophospholipids emulsifier. ns: not significant.

^{a,b}Different letters in the same row denote significant difference among the treatments.

^cSE of arc sin transformation of mortality data.

vs. 116.0 vs. 115.5 g/bird/d, respectively for CON, CONST and VARI groups), while Zaefarian et al. (2015) found a significant increase in feed consumption in broilers fed diets containing 3.5 kg/ton of lysophospholipids. No effect of emulsifiers on feed intake was previously reported by Guerreiro Neto et al. (2011), Aguilar et al. (2013) and Zhang et al. (2011) who used respectively a casein, a nonionic and lysophosphatidylcholine emulsifier.

Birds receiving diets supplemented with the emulsifier presented a significantly lower feed to gain ratio compared to CON (1.871 and 1.875 vs. 1.913 respectively for VARI, CONST and CON; $p < 0.05$) and this result confirms the data found by Melegy et al. (2010). This aspect may be related to the ability of lysophospholipids to ensure a better emulsion of dietary lipids

Table 3. Apparent digestibility of dry matter (DM), crude fat (CF) and crude protein (CP) evaluated from 19 to 24 d.

	CON	CONST	VARI	SE	Probability
Samples/group	45	45	45		
DM, %	59.7	62.9	62.5	1.40	ns
TF, %	59.4	61.5	62.1	2.22	ns
CF, %	60.5	61.3	60.6	1.71	ns

CON: control diet; CONST: control diet +1 kg/ton of lysophospholipids emulsifier; VARI: control diet +1–1.5 kg/ton of lysophospholipids emulsifier. ns: not significant.

and form small liposomes that are absorbed with high efficiency by the animal (Reynier et al. 1985).

In this experiment, mortality percentage was very low in all the experimental groups and no significant difference among the groups emerged. Schwarzer & Adams (1996) observed that the dietary supplementation of lysophospholipids seems to play a positive effect on mortality of broilers. Similar results were also reported by Melegy et al. (2010), while other authors did not observe significant difference due to the use of emulsifiers (Roy et al. 2010; Aguilar et al. 2013; Zaefarian et al. 2015).

Regarding the effect of inclusion level of the emulsifier, no significant difference emerged between CONST and VARI groups for all the considered productive parameters. Also Zhao et al. (2015) did not find significant differences in productive performance of weanling pigs administering diets containing 0.5 or 1 kg/ton of an emulsifier based on lysophospholipids.

The effect of the emulsifier in the different feeding phases was not statistically significant for all the considered productive parameters. On the contrary, Zhang et al. (2011) stated that the use of lysophosphatidylcholine significantly improves body weight gain in broiler chickens from 1 to 21 days.

Apparent digestibility

Table 3 shows the apparent digestibility of dry matter, crude fat and crude protein evaluated from 19 to 24 days. Birds treated with the emulsifier showed no significant effect on digestibility of dry matter (62.9 and 62.5% vs. 59.7%, respectively for CONST, VARI and CON), crude fat (61.5 and 62.1 vs. 59.4%, respectively) and crude protein (61.3 and 60.6 vs. 60.5%, respectively).

On the contrary, Schwarzer and Adams (1996) observed a slight improvement in fat digestibility, nitrogen and dry matter retention when lysophospholipids were added to broiler diets. However, the same authors stated that the use of lysophospholipids and multi-enzymatic complex determine a statistically significant improvement in nutrient digestibility,

showing a possible synergistic effect. Also Zhang et al. (2011) reported no significant effect of lysophosphatidylcholine on digestibility of dry matter and crude proteins in broiler chickens from 14 to 17 and from 35 to 38 days of trial. Nevertheless, these authors stated that the use of lysophosphatidylcholine in broiler diets significantly improves the apparent digestibility of fatty acids as C16:0, C18:1 n9 and C18:1 n7 from 14 to 17 days and C18:2 and C18:3 n3 from 35 to 38 days.

As for productive performance, groups receiving the emulsifier obtained comparable results in terms of nutrient digestibility. Similarly, Zhao et al. (2015) observed no significant difference on nutrient digestibility in weanling pigs fed diets containing two different levels of lysophospholipids.

The efficacy of lysophospholipids on nutrient digestibility is dependent on several factors. Differences in basal diet, especially in sources, composition and inclusion rate of dietary fats and emulsifier could lead to different responses (Zhang et al. 2011; Zaefarian et al. 2015; Zhao et al. 2015). Jansen et al. (2015) reported that the effect of lysophospholipids on nutrient digestibility strongly depends on the fat sources used in broiler diets. In fact, while a statistically significant improvement was observed when lysophospholipids were added to diets containing pig lard, only slight improvement was detected when the emulsifier was included in diet containing soybean oil, being the latter characterised by a high digestibility rate. On the contrary, Zhang et al. (2011) found no significant interactions between fat sources (soybean oil, tallow and poultry fat) and lysophosphatidylcholine on nutrient digestibility in broilers. Conflicting results about the effect of lysophospholipids on digestibility were also recorded in swine. Zhao et al. (2015) stated that lysophospholipids improve nutrient digestibility in weanling pigs fed a low energy diet using beef tallow as fat source. Similarly Dierick and Decuypere (2004) reported a positive effect on digestibility of non-lipids fraction in diet for growing pigs enriched with 4% of animal fats. On the contrary, Xing et al. (2004) observed a linear reduction in the digestibility of dry matter, gross energy and crude proteins when a quantity of 0.1% of lysolecithins was added to diet for piglets till 28 days after weaning. However, the same authors observed a better digestibility of fats using 0.02% of lysolecithin as dietetic supplement for 10 days weaned piglets. Also Soares and Lopez-Bote (2002) observed a different effect of lecithin on fat digestibility depending on the source of dietary fats: the stronger positive effect was detected in diet containing lard respect to those containing soybean oil. Therefore, we suppose that the lack of emulsifier effects on nutrient digestibility

Table 4. Skin colour evaluation.

	CON	CONST	VARI	SE	Probability
no. carcasses	280	280	280		
L (*)	74.3	74.2	74.3	0.12	ns
a (*)	5.77	5.88	5.54	0.15	ns
b (*)	24.9	24.6	24.6	0.20	ns

CON: control diet; CONST: control diet +1 kg/ton of lysophospholipids emulsifier; VARI: control diet +1–1.5 kg/ton of lysophospholipids emulsifier. L (*): lightness; a (*): redness; b (*): yellowness.

observed in our trial may be attributable to the use of soybean oil as lipid source in our diets. In fact, considering the data reported in pigs by Dierick and Decuyper (2004), the use of a highly digestible lipid source, such as soybean oil, may have determined little room for the action of the emulsifier and limited its effectiveness.

Carcass traits

No differences were observed among the experimental groups regarding the eviscerated yield (68.4, 68.7 and 68.3% respectively for CON, CONST and VARI), as well as for the percentage of breast (30.1, 30.2, 30.1%), legs (43.1, 43.1, 43.1%) and unseparated wings (19.1, 19.2 and 19.3%). Similarly, Melegy et al. (2010), Guerreiro Neto et al. (2011) and Aguilar et al. (2013) stated that the dietary use of emulsifiers did not affect carcass yield of broilers, and also Schwarzer and Adams (1996) observed similar slaughter yields in pigs fed diets added with or not an emulsifier based on lysophospholipids.

As for skin pigmentation, values of lightness (L*), redness (a*) and yellowness (b*) resulted similar, showing no significant differences among the groups (Table 4). Skin pigmentation is a relevant quality parameter for poultry industry, since both carcass and meat colour could strongly influence the consumer's choice. Pigmentation is affected by several factors, including quantity, bioavailability and dietary source of pigments (Sirri et al. 2010). Sugawara et al. (2001) reported that lysophosphatidylcholine improves carotenoids absorption by human intestinal cells; however there are no other evidence in literature regarding chicken skin pigmentation.

The results of the evaluation of foot pad dermatitis are reported in Table 5. The percentage of birds that show no lesion (class 0) was similar in the different groups, as well as for the percentage of birds with mild (class 1) or severe (class 2) lesions and thus the Lesion Score resulted similar in the three groups. Foot pad lesions are an important parameter to evaluate the welfare status and rearing condition of broiler chickens. Several factors, with particular regard to litter

Table 5. Incidence of foot pad lesions.

	CON	CONST	VARI
Class 0, %	10.3	9.3	11.9
Class 1, %	70.3	69.9	68.4
Class 2, %	19.4	20.8	19.7
Lesion Score	74.0	76.6	73.4
Chi-square	2.403		

CON: control diet; CONST: control diet +1 kg/ton of lysophospholipids emulsifier; VARI: control diet +1–1.5 kg/ton of lysophospholipids emulsifier.

0: no lesion; 1: mild lesion; 2: severe lesion.

characteristics, are involved in the onset of this injury (Mayne 2005; Meluzzi et al. 2008). It is widely known that nitrogen and fat excretion tend to reduce litter's quality and increase the incidence of food pad lesions. Although no significant difference was observed in this trial, the use of an emulsifier that improves the retention of dietary fats and proteins may have a positive effect on the development of these lesions particularly when raw materials with low digestibility rates are included.

Conclusions

The supplementation of an emulsifier based on lysophospholipids determined a significant improvement of feed conversion rate of broiler chickens, while showed limited effects on the other productive parameters. The positive response of the emulsifier on feed efficiency might be related to a cumulative effect on nutrient digestibility although no significant result was detected when each of those was considered singularly.

The use of two different doses of emulsifier led to the same results for all the considered productive parameters and for nutrient digestibility showing that the lower dose could be the more suitable solution for feed formulation.

Therefore, from the results obtained in this experiment, the use of an emulsifier based on lysophospholipids represents a potential solution to improve feed efficiency of broiler chicken.

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Disclosure statement

The authors report no conflicts of interest. The authors alone are responsible for the content and writing of this article.

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