Scientific Journal of Zoology (2013) 2(6) 64-73
ISSN 2322-293X

Contents lists available at Sjournals

Journal homepage: www.Sjournals.com

Original article

Effect of dietary supplementation of different lutein sources on the productive performance of commercial layers categorized in three body weights

A.A. Sajjad[a], A. Mahmud[a], M. Akram[a], A. Khalique[b,*], F. Hussnain[a], A.S. Haidary[a], U. Khan[a], M. Usman[a]

[a]*Department of Poultry Production, Ravi Campus, University of Veterinary and Animal Sciences, Lahore, Pakistan.*
[b]*Department of Animal Nutrition, Ravi Campus, University of Veterinary and Animal Sciences, Lahore, Pakistan.*

[*]Corresponding author; Department of Animal Nutrition, Ravi Campus, University of Veterinary and Animal Sciences, Lahore, Pakistan.

ARTICLE INFO

Article history:
Received 03 June 2013
Accepted 18 June 2013
Available online 29 June 2013

Keywords:
Lutein supplementation
Production performance
Body weight categories
AMD
Commercial layers

ABSTRACT

Lutein enrichment can be used for reducing chances of age related macular degeneration (AMD) in human being. The present study was conducted to evaluate the production performance of commercial layers categorized in three body weight categories supplemented with different lutein sources. For this purpose a total number of four thirty two 31 week old Hy-line (W-36) commercial layers were categorized in three body sizes (Heavy >1400g, Medium 1300-1399 g, Light <1300) and supplemented with different sources of Lutein (Control, Free, Esterified and Free + Esterified) replicated 6 times containing 6 birds each. The data were collected for production performance (egg production %, egg weight, egg mass, FCR per dozen, FCR per kg egg mass). The data were analyzed using analysis of variance (ANOVA) technique through Completely Randomized Design (CRD). Results of the present study showed non-significant (P>0.05) differences for production performance among different lutein sources and body weight categories except egg weight which was found to be highest in heavy birds. Thus Lutein can be supplemented in layer diet without any harm to its production performance.

1. Introduction

Lutein is a group of natural pigments known as xanthophylls and it is mainly found in fruits, vegetables and eggs (Johnson, 2004). Its colour is yellow-orange and can be used in poultry diets to pigment egg yolks. Its supplementation in human diet can reduce risk of several diseases like age related macular degeneration and cataracts (Ribaya-Mercado and Blumberg, 2004). Lutein is highly bio-available from fats, fat-soluble compounds; in eggs it is mainly present in egg yolk (Chung *et al.,* 2004). Several authors reported that lutein supplementation in layer diet cause an increased lutein concentration in Plasma (Wu *et al.,* 2009) and contents of eggs (Leeson and Caston, 2004). Lutein is mostly found in marigold (Tagets erecta) and its extraction by solvent extraction method has been used to produce lutein additives (Breithaupt, 2002). Some authors (Li *et al.,* 2007) reported a better stability of esterified lutein then that of free lutein, under the same challenge of light and heat. Both free and esterified lutein can be added in the diets of layer to increase the lutein contents of eggs (Wu *et al.,* 2009). Hydrolysis rate of esterified lutein is 40 to 60% than free lutein so absorbance of free lutein is higher than its esterified form (Hencken, 1992). Best utilization of lutein esters than free lutein is seen in laying hens because it is assumed that solubility of lutein esters is superior in fats (Philip *et al.* 1976). The results of colour measurements of yolk showed that there is identical absorption tendency of same level of free and esterified lutein in diet (Lai *et al.* 1996). However, no study yet focused on the comparison of the production performance of birds fed free and esterified lutein. So, the present study was conducted with the objective to investigate and compare the production performance of birds supplemented with different lutein sources.

2. Materials and methods

The present study was conducted at commercial layer farm with the objective to investigate the effect of dietary lutein supplementation on production performance of hens of different body sizes. In this study Four thirty two Hy-Line W-36 commercial layers (31-wk-old) were categorized in three body weights i.e. heavy (1400-1500g) medium (1301-1400g) and light (1201-1300g) were randomly divided into four Lutein treatments, with 108 birds in each body weight for a period of 4 weeks. Each treatment was replicated 6 times with 6 birds in each replicate. Different lutein sources (free, esterified, free + esterified) were added @ 500mg/kg in commercial layer diet formulated keeping in view NRC, (1994). Hens were maintained in semi-environment control house in A type cages with each deck measuring 28.5 inches long, 17 inches wide, and 16.5 inches high. The birds were kept under standard management conditions with adlibitum water supply, 16 hour light. Daily feed allowance was provided to birds according to the recommendation of the company as prescribed in the guide.

2.1. Data collection

The data were collected on daily basis for feed intake egg production and egg weight and then used for calculating egg mass, FCR per dozen eggs and FCR per kg egg mass.

2.2. Statistical analysis

The data were analyzed using ANOVA in factorial arrangement through Completely Randomized Design using SAS 9.3. Means were compared using Duncan's multiple range tests.

3. Results and discussion

3.1. Egg production (%)

Results of the present study showed non-significant ($P>0.05$) differences in means (Table 1) as well as in weekly trend (Fig1) of egg production (%) among three body weight categories. This might be due to good uniformity of the flock having narrow body weight ranges and performing at peak production phase. Lutein sources also could not show any significant ($P>0.05$) differences in means (Table 1) as well as in weekly trend (Fig 2) of egg production (%). Lutein is reviewed to enrich the egg yolk and not to affect the egg production. The similar findings have been reported by Leeson and Caston, (2004) who found non-significant effect of lutein on egg production. Similarly, Grashorn and Steinberg (2002) also studied the transfer of xanthophylls from feed to the eggs and could not observe any effect on laying performance.

3.2. Egg weight (g)

Results of the present study showed significant ($P<0.05$) differences in means (Table 1) as well as in weekly trend (Fig3) of egg weight among three body weight categories. Significantly ($P<0.05$) higher egg weight for heavy body weight category might be attributed to largest pre-ovulatory follicle and the oviduct in the heavier birds causing them to produce heavier eggs (Joyner *et al*., 1987). The similar findings have been reported by Juliank and Christians (2002) that egg size increases with advancement of age in birds. However, different sources of lutein showed non-significant ($P>0.05$) differences in means (Table 1) as well as in weekly trend (Fig 4) of egg weight. Similarly, in another study Rosa *et al*. (2012) also reported non-significant differences among different lutein enriched diets on egg weight.

3.3. Egg mass

Results of the present study showed non-significant ($P>0.05$) differences in mean (Table 1) as well as in weekly trend (Fig 5) of egg mass among different body weight categories which could be attributed to the stage of the production, because all the experimental birds were in peak production. After feeding lutein enriched diets the results showed non-significant ($P>0.05$) differences in mean (Table 1) as well as in weekly trend (Fig 6) of egg mass. Being egg mass the product of egg number and egg weight as both were not affected independently so could not produce any significant different in combination by lutein sources. Results of the present study also agreed with results found by Gracia *et al.* (2002) who reported non-significant difference of xanthophyll enriched diets on laying characteristics. Similarly another study (Hossain *et al.,* 1998) who also reported non-significant effect of vitamin E (another anti oxidant) enriched diets on egg weight and laying rate ultimately not influencing the egg mass.

3.4. FCR/dozen

Results of the present study showed non-significant ($P>0.05$) differences in means (Table 1) as well as in weekly trend (Fig 7) of FCR per dozen among different body weight categories which might be attributed to the stage of the production, because all the experimental birds were in peak production phase. As FCR per dozen is calculated by feed intake and egg production so by producing same number of eggs with consuming same amount of feed could not show significant difference for FCR per dozen. Lutein sources did not affect significantly the means (Table 1) as well as in weekly trend (Fig 8) of FCR/dozen eggs. This may be attributed to the non significant effect of lutein sources on feed intake and egg production (%) consequently showing the non- significant ($P>0.05$) effect of different lutein sources on FCR per dozen. Results of the present study are in accordance with another study (Leeson and Caston, 2004) who also reported that lutein enriched diet had no effect on FCR per dozen egg. The same outcomes were observed by Garcia *et al.* (2002) who used different levels of xanthophyll pigment canthaxanthin in layer diets and observed non-significant effect on feed conversion ratio.

3.5. FCR/Kg egg mass

Present study showed non-significant ($P>0.05$) differences in means (Table 1) as well as in weekly trend (Fig 9) of FCR per kg egg mass among different body weight categories which could be attributed due to the peak production phase of the experimental birds. As FCR per kg egg mass is derived from feed intake and egg mass and egg mass was not affected by different lutein sources (Hossain *et al*., 1998) and feed allowance was constant so FCR per kg egg mass was not affected. Present study showed non-significant ($P>0.05$) differences in means (Table 1) as well as in weekly trend (Fig 10) of lutein enriched diets on FCR per kg egg mass. The outcomes of the present study are in accordance with another study (Grashorn and Steinberg 2002) who also reported transfer of xanthophylls from feed to the eggs which did not affect laying performance and daily feed consumption. These results also agreed with those of Angeles and Scheideler (1998) who evaluated 2 basal diets, corn gluten and alfalfa meal and observed non-significant difference on laying rate and feed intake.

Table 1
Production performance as affected by different lutein sources and body sizes.

Variables	Performance Traits				
	Egg (%)	Egg weight (g)	Egg mass (g)	FCR / dozen	FCR / Kg egg mass
Lutein Sources					
Free	87.46±1.30	61.43±0.20	1504.43±22.8	1.37±0.02	1.86±0.03
Esterified	88.82±0.85	61.51±0.27	1530.08±17.93	1.35±0.01	1.83±0.02
Free + esterified	88.09±1.08	61.78±0.29	1523.62±19.53	1.36±0.01	1.84±0.02
Control	90.50±0.65	61.85±0.41	1567.86±17.30	1.32±0.009	1.78±0.02
Body weight Categories					
Heavy	88.02±1.01	62.74±0.23[a]	1546.73±20.52	1.36±0.01	1.81±0.02
Medium	89.21±0.86	61.56±0.17[b]	1537.87±16.19	1.34±0.01	1.82±0.01
Light	88.93±0.77	60.63±0.17[c]	1509.89±14.17	1.35±0.01	1.85±0.01
Lutein sources	0.17	0.72	0.14	0.17	0.15
Body weight	0.613	<0.001	0.291	0.60	0.38
Lutein × body weight	0.21	<0.001	0.04	0.21	0.06

Different alphabets on means show significant differences at P<0.05

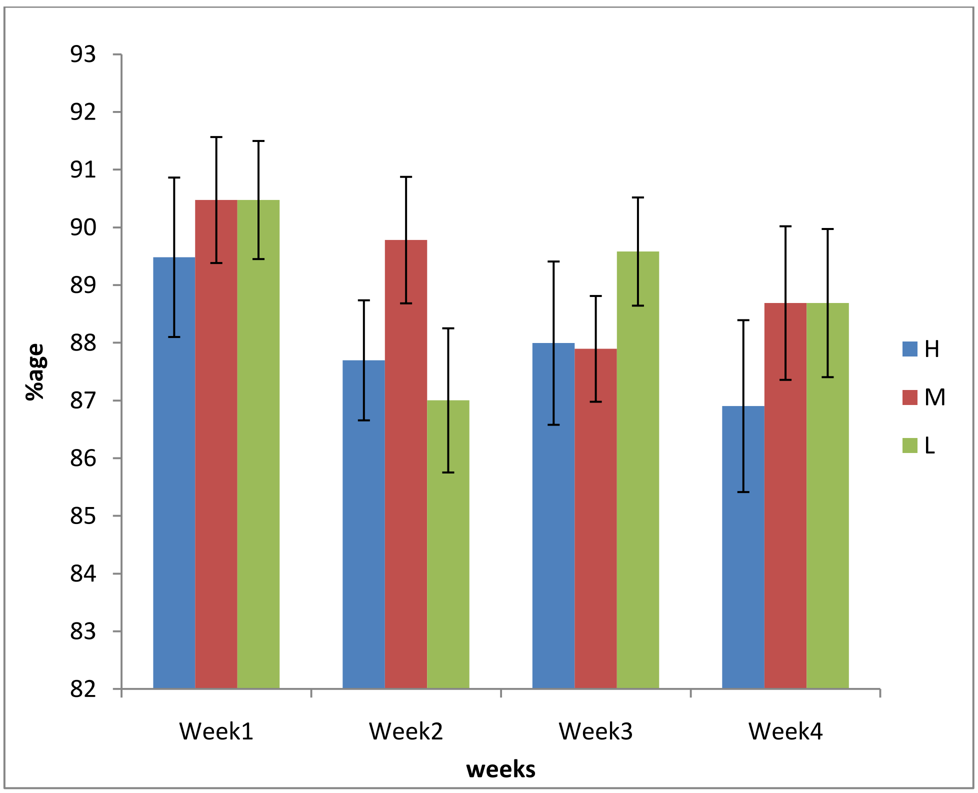

Fig. 1. Weekly trend in egg production% influenced by3 body weight categories.

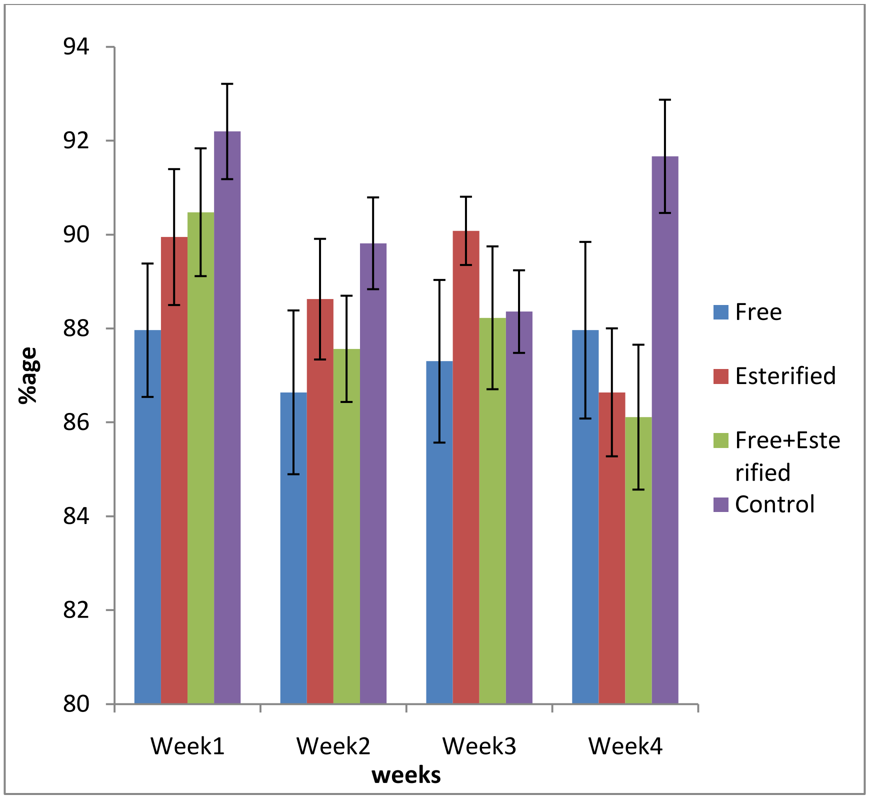

Fig. 2. Weekly trend in egg production% influenced by different lutein.

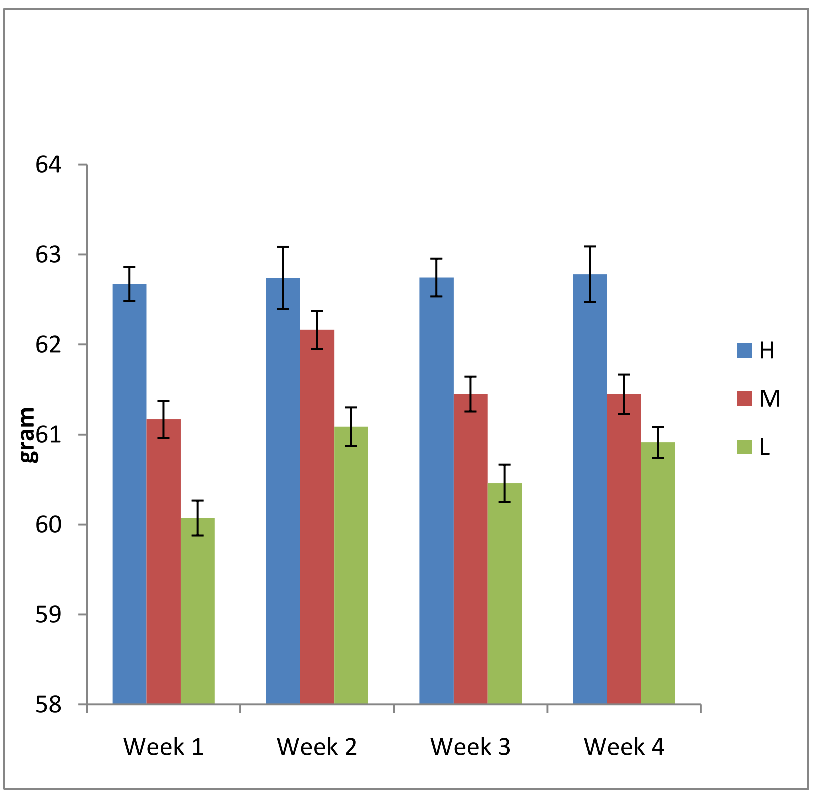

Fig. 3. Weekly trend in egg weight influenced 3 body weight categories.

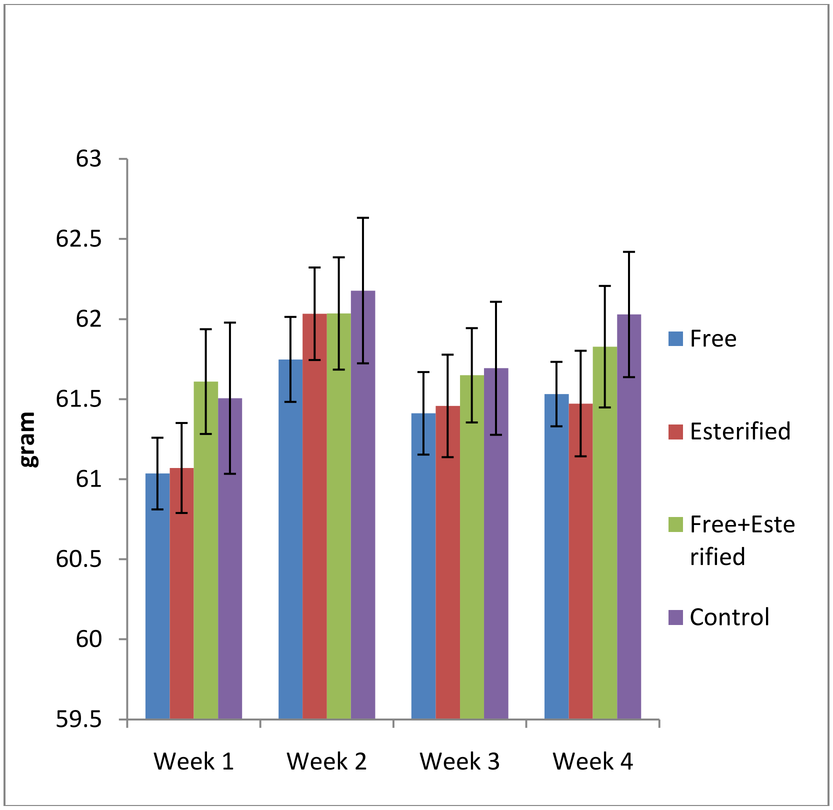

Fig. 4. Weekly trend in egg weight influenced by different lutein sources.

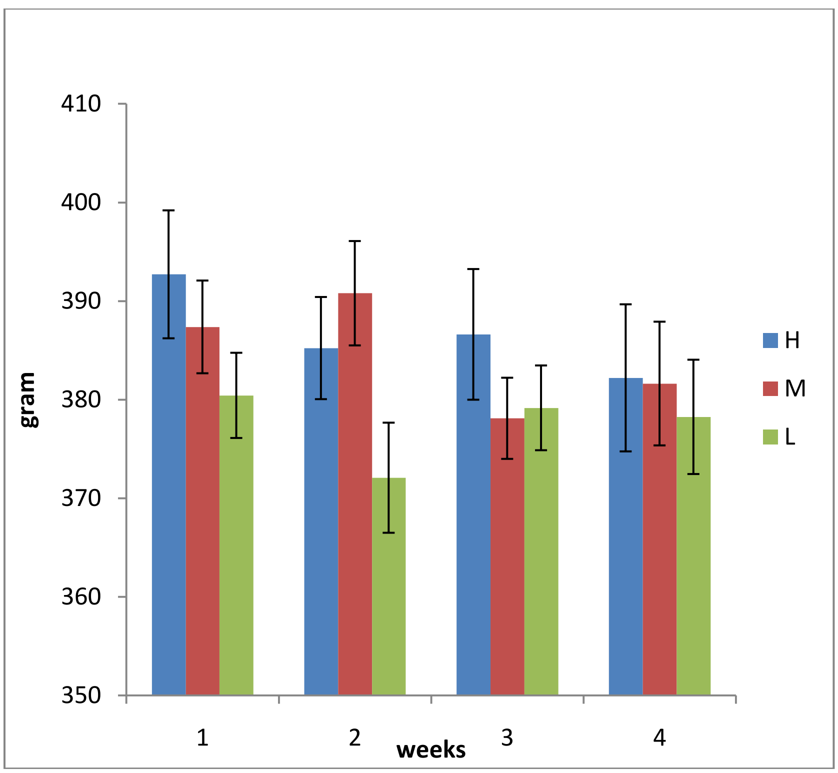

Fig. 5. Weekly trend in egg mass influenced by3 body weights.

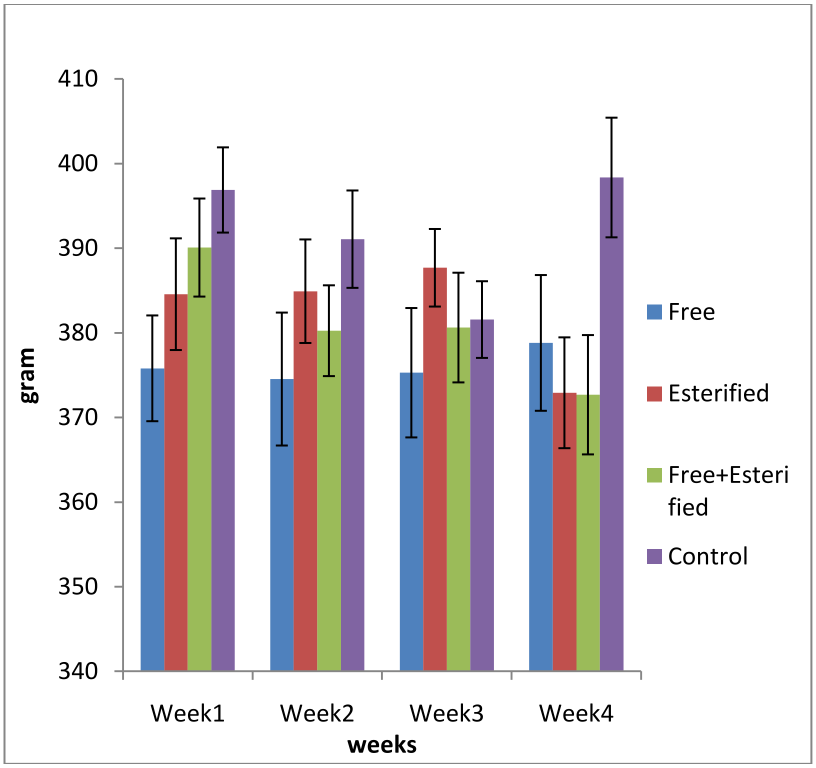

Fig. 6. Weekly trend in egg mass influenced by different lutein sources.

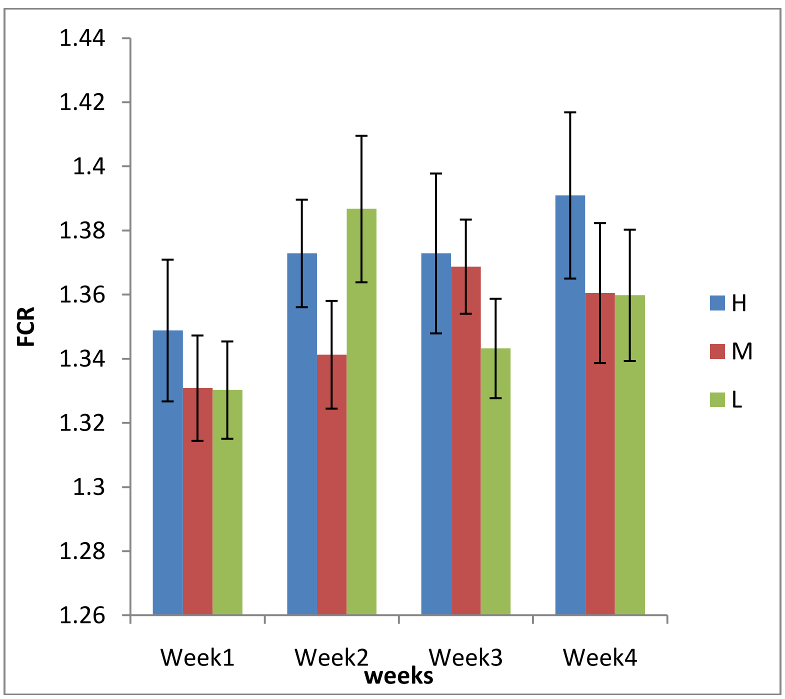

Fig. 7. Weekly trend in FCR per dozen influenced by 3 body weight categories.

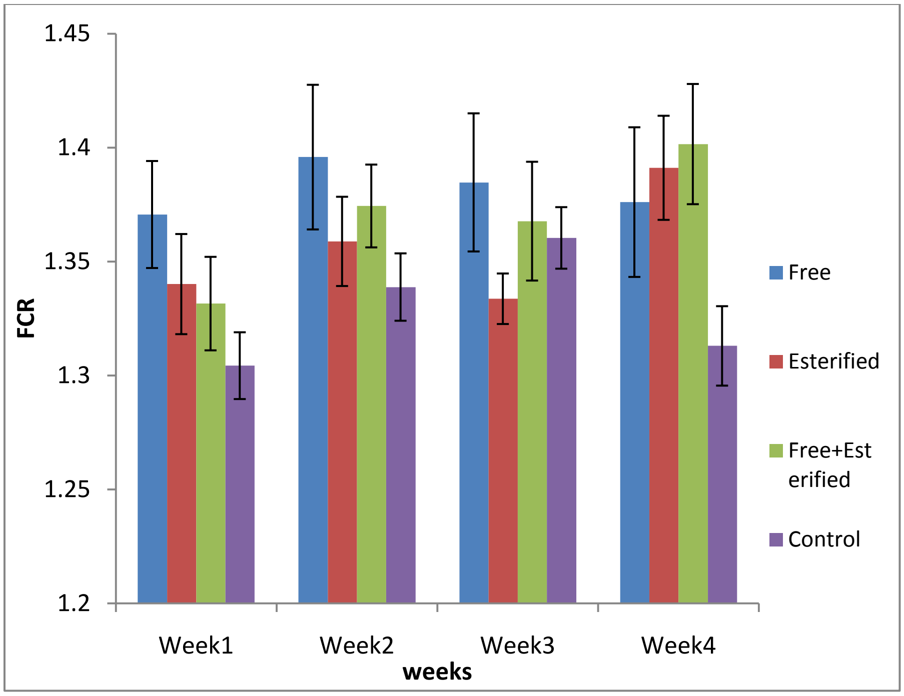

Fig. 8. Weekly trend in FCR per dozen influenced by different lutein sources.

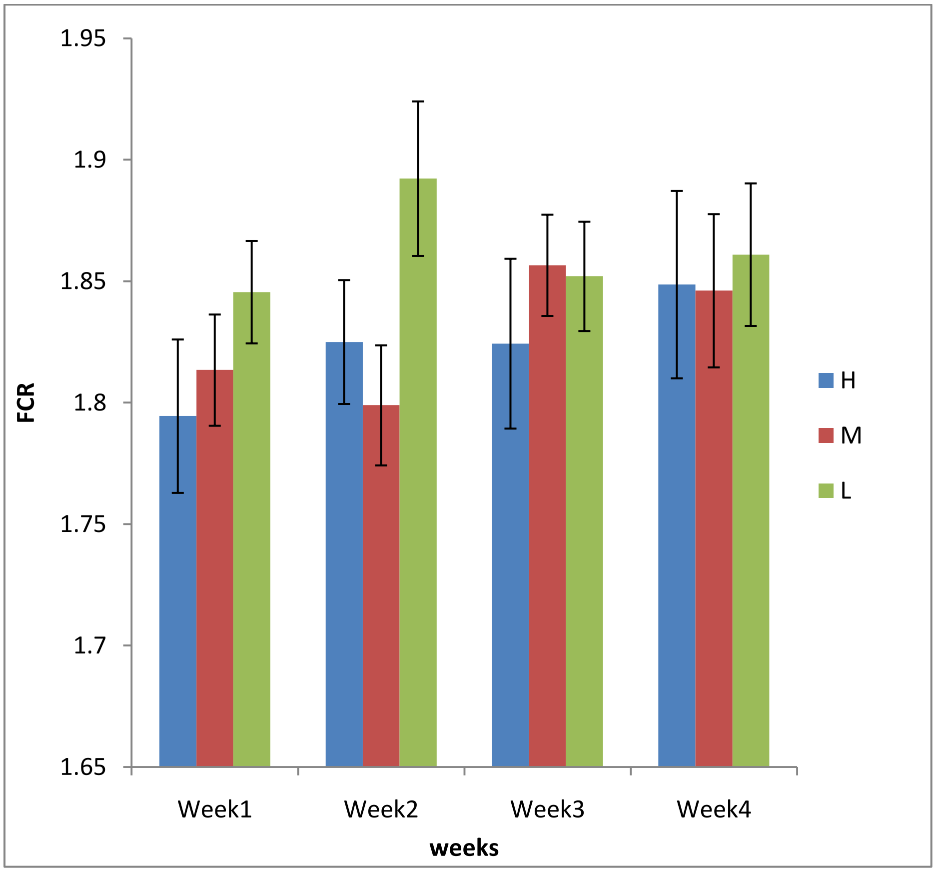

Fig. 9. Weekly trend in FCR per kg egg mass influenced 3 body weight sizes.

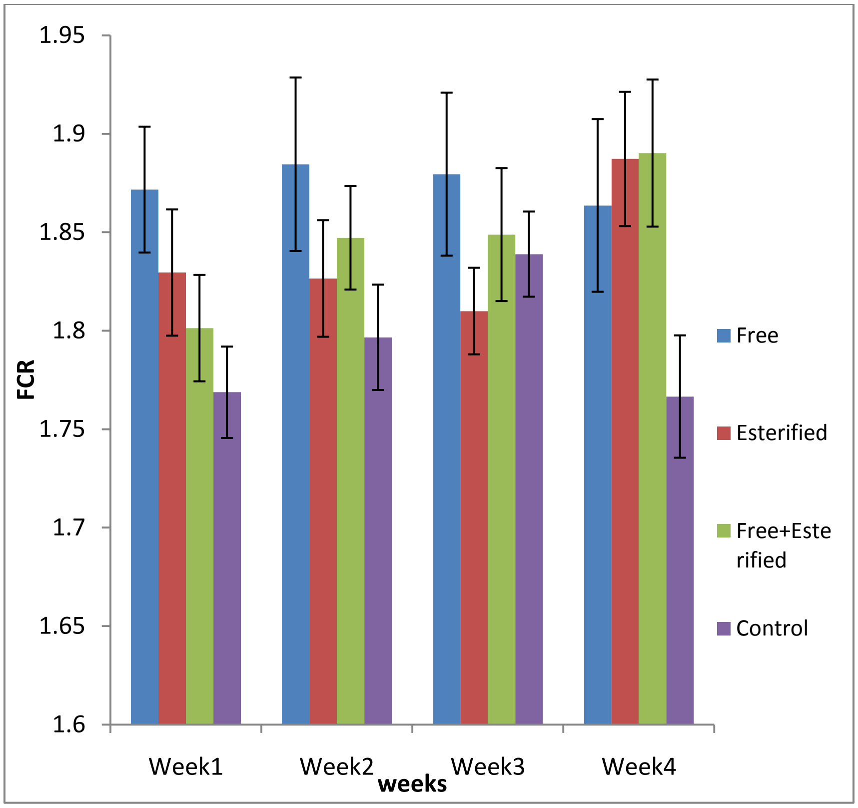

Fig. 10. Weekly trend in FCR per kg egg mass influenced lutein sources.

References

Scheideler, A.M.S., 1998. Effect of diet, level, and source of xanthophyll on hen performance and egg yolk pigentation. Poult Sci. 77(Suppl. 1),18. (Abstr.)

Breithaupt, D.E., Wirt, U., Bamedi, A., 2002. Differentiation between lutein monoester regioisomers and detection of lutein diesters from marigold flowers (Tagetes erecta L.) and several fruits by liquid chromatography-mass spectrometry. J. Agri. and Food Chem. 50, 66-70.

Chung, H.Y., Rasmussen, H.M., Jornson, E.J., 2004. Lutein bioavailability is higher from lutein-enriched egg than from supplements and spinach in men. J. Nutrition. 134, 1887–1893

Eiichi, K.N., Nagao, A., 2011. Absorption and Metabolism of Xanthophylls. National Food Research Institute, National Agriculture and Food Research Organization, 21-12 Kannondai, Tsukuba, Ibaraki 305-8642, Japan.

Garcia, E.A., Mendes, A.A., Pizzolante, C.C., Goncalves, H.C., Oliveira, R.P., Silva, M.A., 2002. Effect of canthaxanthin levels on performance and egg quality of laying hens. Braz. J. Poult Sci. 4, 1–4.

Grashorn, M.A., Steinberg W., 2002. Deposition rates of canthaxanthin in egg yolks. Arch. Geflugelk. 66, 258–262.

Hencken, H., 1992. Chemical and physiological behaviour of feed carotenoids and their effects on pigentation. Poult Sci.71, 711-717.

Hossain, S.M., Barreto, S.L., Bertechini, A.G., Riosa, A.M., Silva, C.G., 1998. Influence of dietary vitamin E level on egg production of broiler breeders and on the growth and immune response of progeny in comparison with the progeny from eggs injected with vitamin E. Anim. Feed Sci. Technol. 73, 307–317.

Johnson, E.J., 2004. A biological role of lutein. Food Reviews International; 20(1), 1-16.

Joyner, C.J., Peddie, M.J., Taylor, T.G., 1987. The effect of age on egg production in the domestic hen. Gen. and Compar. Endocrin. 65, 331-336.

Juliank, K.C., 2002. Avian egg size: variation within species and inflexibility within individuals. Biol. Rev., 77, 1-25.

Lai, S.M., Gray, J.I., Flegal, C.J., Cooper, T., 1996. Deposition of carotenoids in eggs from hens fed diets containing saponified and unsaponified oleoresin paprika. J. Science. Food Agric. 72,166–170.

Leeson, S., Caston, L., 2004. Enrichment of Eggs with Lutein. Department of Animal and Poultry Science, University of Guelph, Ontario, Canada N1G 2W1. Poult Sci. 83,1709–1712.

Li, D.J., Fang, G.Z., Liu, C.Q., Yu, J.P., 2007. Stability of lutein and its esters. Chemistry and Industry of Forest Products; 27(1),112-6.

Philip, T., Weber, C.W., Berry, J.W., 1976. Utilization of lutein and lutein-fatty acid esters by laying hens. J. Food Sci. 41, 23–25.

Blumberg, R.J.D., 2004. Lutein and zeaxanthin and their potential roles in disease prevention. J. Am. Coll. Nutr. 567S-587S.

Rosa, A.P., Scher, A., Sorbara, J.O.B., Boemo, L.S., Forgiarini, J., Londero, A., 2012. Effects of canthaxanthin on the productive and reproductive performance of broiler breeders. 91, 660–666.

Wu, L., Huang, X., Shi, K., Tan, R., 2009. Bioavailability Comparison of Free and Esterified Lutein for Layer Hens. Hubei Key Laboratory of Anim. Nut. and Feed Sci. Wuhan Polytechnic University, Wuhan, Hubei 430023, P. R. China.