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RESEARCH ARTICLE

Production of Eggs with Enriched Nutritional Value (Designer Eggs) Using Feeds containing Herbal Supplements

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ABSTRACT

Value addition of table eggs with use of herbal supplements in the poultry feed such as garlic, fenugreek and bay leaves was carried out to decrease cholesterol levels in the yolk. Our study revealed that supplementation of the feed with garlic resulted in high hypolipidemic activity, in the egg yolk. On the other hand, supplementation of the feed with fenugreek and bay/curry leaves resulted in the production of eggs with high levels of Vitamin E and Selenium content. Thus, our data shows that hens fed with these herbal feed supplements produced enriched eggs with higher level of omega-3 polyunsaturated fatty acid content that is beneficial to health. Hence, our study reveals that eggs with enriched nutritional value (designer eggs) can be produced by feeding hens with a diet containing herbal feed supplements.

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INTRODUCTION

With the advent of eggs containing enhanced nutritional value (designer eggs) gaining increased popularity in many countries, current research is geared towards making eggs more nutritious via various techniques. The value addition to eggs can either be done prior to oviposition or after oviposition (Ezhilvalavan *et al.,* 2003). Designer or enriched eggs are examples of pre-oviposition value added products;these eggs were enriched with nutrients like n-3 poly unsaturated fatty acids (PUFA), vitamin E, selenium, folic acid, lutein, antioxidants and immunomodulators. Several researchers have incorporated many health-promoting components into the already nutrient rich eggs (Sujatha 2002, Kirubakaran 2003 and Narahari *et al*., 2004).

Examples of health-promoting components include garlic, fenugreek and bay leaves. Garlic *(Allium sativum)* has potential hypolipidemic, hypotensive, hypoglycemic, hypothrombotic, hypoatherogenic and galactogenic properties (Bordia *et al.,* 1975, Sklan *et al.,* 1992, Chowdhury *et al*., 2002). Fenugreek seeds *(Trigonellafoenum)* have hypoglycemic, hyperinsulinemic, hypolipidemic (Sowmya *et al.,* 1999) properties and also have a unique property to reduce platelet aggregation (Hannan *et al.,* 2003). The commonly used spice, bay or curry leaves *(Murryakoeingii)* is traditionally consumed bydiabetics in southern parts of India. Bay leaves have been shown to contain hypoglycemic principles (Yadav *et al.,* 2002). Alkaloids from bay leaves have antioxidative properties (Tachibana *et al.,* 2003). Chowdhury *et al*., (2002) also observed cholesterol reduction properties of dietary garlic in laying hens. Based on the earlier research work and as well as present day requirements of the consumers, this research work was undertaken to produce eggs enriched with herbal active principles (designer eggs). Thus, our goal was to produce eggs having antioxidants, immunomodulating and overall health-promoting properties/qualities.

MATERIALS AND METHODS

A biological study of 12 weeks duration was carried out in Poultry research station Nandanam, Chennai to

produce herbal-enriched nutritious eggs. One hundred and forty four Single Comb `Forsgate' strain White Leghorn layers aged70 weeks, belonging to the same hatch and of uniform body size were randomly grouped into six treatments with four replicates of 6 hens each. The treatments consisted of the following groups: 1. control - Regular layer mash (T_1), 2. functional feed(FF) - layer mash having oil rich sardine fish, linseed oil, mustard oil and antioxidants (T_2), 3. FF + garlic at 6g/kg (T_3),4. FF+ fenugreek seeds at 6g/kg (T_4), 5. FF+ bay leaves (Curry leaves) at 6g/kg (T_5) and 6. FF+ 2g each of garlic, fenugreek seeds and bay leaves/kg (T_6). The ingredients and chemical composition of experimental feeds are shown in Table 1 and 2. All the diets were isonitrogenous and isocaloric and the birds were maintained in deep litter up to 81 weeks of age.

Table 1: Composition of the experimental layer feeds (g/ kg)

Ingredient	Control feed (T_1)	Functional feed (T_2 - T_6)
Maize	300	300
Bajra (Pearl millet)	280	200
Rice bran	-	91.4
Sun flower oil cake	130	130
Soya bean meal	173	70
Linseed oil (flax seed)	-	10
Mustard oil	-	10
Full fat Sardine fish	-	100
Di-calcium phosphate	10	-
Shell grit	100	80
Salt	3	2.5
Sodium bicarbonate	2.0	2.0
Trace Mineral mixture	1.0	1.0
Vitamin premix	0.5	0.5
Sel-plex (organic selenium)	-	0.2
Choline chloride 60%	0.5	1
Vitamin –E 50%	-	0.2
Spirulina	-	1
Ethoxyquin (antioxidant)	-	0.2

Table 2: Chemical composition of the experimental diets

Nutrient	Control Feed (T_1)	Functional Feed (FF) (T_2 - T_6)
CP* (g/kg)	168.8	170.2
ME** (MJ/kg)	10.82	11.57
EE* (g/kg)	21.7	61.0
Calcium* (g/kg)	35.2	35.3
Total phosphorus* (g/kg)	4.5	5.8
Lysine** (g/kg)	8.1	8.8
Methionine** (g/kg)	3.6	4.4

* Analyzed values; ** Calculated values; CP-crude protein, ME-metabolizable energy, EE-ether extract.

Biochemical assay of eggs

Yolk cholesterol levels were estimated from boiled yolk samples (Washburn and Nix, 1974) the raw yolk samples were used for the estimation of carotenoid pigment (Bligh and Dyer, 1959).The Vitamin E levels in the yolk samples were measured by using HPLC (Abdollahi *et al*., 1993). The selenium level in the pooled egg contents were estimated using Atomic Absorption Spectrophotometer as described previously (Cantor and Tarino1982). Methyl esters of fatty acids (fatty acid estimation) were prepared from yolk sample, as described previously (Wang *et al.,* 2000) and measured using gas chromatography.

Data analysis

All the data collected were subjected to analysis of variance for significance according to the methods of Snedecor and Cochran (1989) for a Completely Randomized Design.

RESULTS AND DISCUSSION

The influences of the six dietary treatments are shown in Table 3 and 4. Highly significant ($P<0.01$) reduction in yolk cholesterol levels was noticed upon feeding of five special diets, especially FF + garlic (Table 3). The reduction in the yolk cholesterol levels observed in this study ranges between 11.25% in FF eggs to as low as 30.88% in the FF + garlic feed. Thus, dietary garlic appeared be a powerful hypocholesterimic agent. Chowdhury *et al*., (2002) also observed cholesterol reduction properties of garlic in layers. The carotenoids pigment levels of the yolk were also influenced by the five special diets fed to the hens. High oil content in the FF and other herbal functional feeds was responsible for accumulation of more carotenoid pigments into the yolks. Bay leaves which are a source of high carotenoid content, further improved the colour of the yolk by depositing more carotenoids. A darker yolk colour was recorded due to increased carotenoid content in the functional feeds (Sujatha 2002, Kirubakaran 2003, and Narahari *et al*., 2004).

The yolk vitamin E and egg (albumen+yolk) selenium levels were influenced by our dietary treatments. All the five functional diets had significantly ($P<0.05$) higher vitamin E and selenium levels than the control (Table 3). Supplemented vitamin E in the functional feeds coupled with higher oil content in the functional feeds was able to result in deposition of increased vitamin E in the functional egg yolks. Jiang *et al*., (1992), Cherian *et al*., (1996), Galobart *et al*., (2001), Sujatha (2002), Kirubakaran (2003) and Narahari *et al*. (2004) noticed significantly higher vitamin E levels in the functional eggs (eggs produced upon feeding functional feed) than in the regular eggs. Selenium supplementation in the functional feeds in combination with mutual sparing action of Vitamin E and Selenium, resulted in significantly ($P<0.05$) higher selenium levels in the functional eggs (Table 3). FF + bay leaves treatment recorded the highest selenium levels in the egg, probably due to presence of inherent selenium in bay leaves. Surai (2001), Sujatha (2002), Kirubakaran (2003) and Narahari *et al*., (2003 and 2004) reported higher selenium levels in the selenium enriched functional eggs, than the regular eggs.

In yolk lipids, the percentages of saturated fatty acids (SFA), monounsaturated fattyacids (MUFA), ($C_{18:2}$) linoleic acid (n-6 polyunsaturated fattyacids (PUFA)) and linolenic acid (n-3 PUFA) in different dietary treatments were studied. The results revealed that the n-3 PUFA level increased significantly ($P<0.01$) with proportionate reduction in SFA ($C_{16:0}$ palmitic acid) level in all the five functional feed treatments, compared to control. The MUFA ($C_{18:1}$ oleic acid) level increased significantly in the FF + fenugreek only; whereas n- 6 PUFA level was significantly ($P<0.05$) higher in the control. Similarly, Ezhilvalavan *et al*., (2003) reported that designer egg yolk had higher n-3 PUFA and MUFA, lower levels of

Table 3: Effect of dietary treatments on yolk cholesterol, yolk carotenoid pigments, yolk vitamin E and selenium levels in egg

Trait	Control	FF	FF+garlic	FF+fenugreek	FF+bay leaves	FF+garlic+ fenugreek+ bay leaves	'F' value
YolkCholesterol (mg/g) [1]	13.05±0.31	11.60±0.10	9.02±0.26	10.63±0.12	10.95±0.17	10.74±0.23	36.57**
Yolk Carotenoids[1] (mcg/g)	48.00±0.52	64.01±0.68	64.83±0.31	68.67±0.49	69.83±0.63	68.33±0.21	59.21**
Yolk Vitamin E (mcg/g)[2]	80.0±0.82	194.8±1.30	214.3±1.20	190.2±1.01	210.3±0.76	215.0±1.01	75.44**
Egg Selenium (ng/g) [2]	118.5±1.80	260.5±1.26	269.3±0.84	260.5±1.26	279.5±0.76	281.3±1.28	52.11**

1(n=48), 2(n=24); **highly significant (P<0.01); FF-functional feed; F-value; one way ANOVA, F-distribution test statistics values

Table 4: Effect of dietary treatments on fatty acid composition of yolk lipids (g/ 100g of Total Fatty Acid) (n=24)

Trait	Control	FF	FF+garlic	FF+fenugreek	FF+bay leaves	FF+garlic+fenu-greek+bay leaves	'F' value
Palmitic	0.407±0.005	0.267±0.007	0.142±0.009	0.235±0.007	0.265±0.006	0.140±0.004	23.13**
Palmitoleic	27.30±0.17	18.99±0.60	14.65±0.16	19.05±0.11	19.53±0.15	15.30±0.15	130.2**
Stearic	7.31±0.07	7.38±0.02	6.88±0.01	7.41±0.03	7.25±0.05	7.04±0.08	3.01*
Oleic	43.88±0.11	44.22±0.16	43.52±0.15	44.58±0.19	44.23±0.16	43.88±0.17	4.52**
Linoleic	15.43±0.09	14.75±0.06	13.62±0.15	14.62±0.07	14.85±0.14	14.49±0.09	6.81**
Linolenic	0.18±0.08	5.36±0.14	7.18±0.37	6.53±0.46	6.88±0.23	7.12±0.42	166.17**
EPA	0.06±0.005	0.32±0.015	0.63±0.019	0.40±0.016	0.38±0.018	0.41±0.017	26.48**
DHA	0.15±0.06	4.70±0.14	5.02±0.52	4.21±0.21	4.26±0.22	4.91±0.24	86.45**
OFA	4.00±0.16	3.65±0.13	3.31±0.11	4.44±0.25	3.63±0.16	3.89±0.12	3.50*

F-value; one way ANOVA, F-distribution test statistics values; **highly significant (P<0.01); *Significant (P<0.05); EPA-Eicosapentaenoicacid DHA-Docosahexaenoicacid OFA-Other fattyacids

n-6 PUFA and SFA, compared to standard egg. Eicosapentaenoic acid (EPA) and Docosahexaenoic acid (DHA) levels were significantly improved in all the five functional feed treatments, Sujatha (2002), Narahari (2003) and Narahari *et al*. (2004) also reported significant increase in the yolk EPA and DHA levels, due to feeding of hens with oil rich fish or fish oil, compared to the regular egg yolks.

Conclusions

Based on this study, it may be safely concluded that herbal enriched functional egg, rich in n-3 PUFA, antioxidants like Vitamin E, Selenium, carotenoids and other herbal active principles can be produced by feeding hens with functional feeds containing herbal ingredients. This herbal enriched functional feeds, not only improved the general health and immune status of the hens, but also incorporated these health-promoting ingredients into the egg. Consumption of such herbal enriched functional eggs by humans may significantly improve their health.

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