RESEARCH ARTICLE

Effect of Dietary Supplementation of Yellow Mustard Seed Powder and Mango Leaf Powder on Production Performance of Commercial Layers

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Abstract

The study was carried out to discern the effect of incorporating yellow mustard seed powder in diet on production performance, nutrient utilization, and egg quality of commercial laying hens. Ninety White leghorn Laying hens of 18 week were randomly distributed into three treatment groups with 30 birds per treatment with three replicates each and were subjected to feeding experiment. Hens of T_1(control) group were fed with basal diet, whereas in T_2 group yellow mustard seed powder @ 0.5% and in T_3 group combination of mango leaf powder (0.25%) and yellow mustard seed powder (0.25%) was supplemented. Inclusion of yellow mustard seed powder in diets of layer birds significantly decreased feed intake ($p \leq 0.05$), egg production ($p \leq 0.05$), FCR ($p \leq 0.05$) and body weight ($p \leq 0.01$). Highly significant difference ($p \leq 0.01$) was observed in dry matter utilization, egg weight, egg NFE while significant difference ($p \leq 0.05$) was observed in feed crude protein, ether extract, NFE, glucosinolate, crude protein utilization, organic matter utilization, egg shape index, egg shell thickness, egg ether extract, egg Ca and P and egg triglyceride.

Keywords: Egg Production, Feed Conversion Ratio, Feed Intake, Yellow Mustard Seed Powder, White Leghorn Layers.

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Introduction

Recent studies showed that spices and medicinal plants influence the gut microbiota, immunity and antioxidant status (Zhang *et al.,* 2017; Vase-khaveri *et al*., 2019; Adu *et al*., 2020). Yellow mustard (Brassica alb plant) seed used as spice in every household has high protein content (Jhiang, 1999) but low tannins (Slominski *et al*., 1994) and fibre (Rahman and McVetty, 2011). It is rich in unsaturated fatty acids (Benson and Devi, 2009), flavonoids, and minerals with less antinutritional compounds It has antibacterial, antifungal and anticancerous anthelminthic lipid-lowering property. Mango leaf possesses phytochemicals like mangiferin which is responsible for anti-inflammatory, antimicrobial, antioxidant and other medicinal properties (Luo *et al*., 2012; Sultana *et al*., 2012). Due to its high glucosinate content, whole yellow mustard seed has not been used for feeding poultry but used as cake or meal (Alexander *et al*., 2008). There is no information on the potential of yellow mustard seed, either alone or in combination with mango leaf as an alternative to antibiotics and its effect on production performance and egg quality in white leghorn layers. Therefore the present study was undertaken to assess the effect of supplementing yellow mustard seed powder and mango leaf powder on the production performance of commercial layers.

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MATERIALS AND METHODS

Experimental Birds and Diet

The present study was conducted for 12 weeks at Instructional Poultry Farm, Nagla, G.B.Pant University of Agriculture and Technology, Pantnagar, in strict compliance with guidelines of the Institutional Animal Ethics Committee (IAEC). Ninety White leghorn Laying hens of 18 week were randomly distributed into three treatment groups with 30 birds per treatment with three replicates each and were reared in

California battery cages using standard management and health care practice. The experimental diets were prepared as per BIS (2007) specification. The three dietary treatment groups included T_1: Control containing Basal diet; T_2 Basal diet supplemented with yellow mustard seed powder @ 0.5%; and T_3 Basal diet supplemented with a combination of mango leaf powder (0.25%) and yellow mustard seed powder (0.25%) for a period of 12 weeks.

Preparation of yellow Mustard Seed Powder and Mango Leaf Powder

Yellow mustard seeds were procured from the local market of Pantnagar (Uttarakhand, India) while mango leaves were harvested from the Department of Horticulture, G.B.P.U.AT, Pantnagar, (Uttarakhand), India.Yellow mustard seeds were ground to powder in a mixer grinder and refrigerated in air-tight containers until used. Mango leaves were first shade dried for 3-4 days before sun-drying on clean concrete surface. The leaves were then placed in hot air oven at 70°C till their constant weight was achieved. The dried Mango leaves were finely ground to powder and stored in air-tight polythene bags in a cool and dry place.

Proximate Analysis

Proximate analysis of yellow mustard seed powder, mango leaf powder, experimental diets, excreta and egg samples were done following AOAC (2003), while spectrophotometric estimation of glucosinolate was done using methanolic extract prepared by homogenizing 0.1 g defatted sample (feed) in a 2 mL vial with 80% methanol (Mawlong *et al.,* 2017). Total glucosinolates in yellow mustard seed and experimental diets were calculated by using the formula $y = 1.40 + 118.86 \times A_{425}$, where A is the absorbance at 425 nm. Total phenol in intervention ingredients and egg was estimated by Folin Ciocalteu method as described by Singleton *et al.* (1999).

Production Parameters

Production parameters such as egg production (%), feed intake (g/bird/day), FCR (kg/dozen egg) and body weight fortnightly were recorded for a period of 12 weeks. A metabolic trial was conducted at the end of the feeding experiment to assess nutrient utilization by the laying hens.

Egg Quality Traits

In the last week of the feeding trial, two eggs from each replicate were collected to assess the egg quality parameters. External egg quality parameters such as egg weight, shell weight, shell thickness, shape index, albumen weight, albumen height, Haugh unit, and internal egg quality parameters such as yolk weight, yolk index, yolk cholesterol and triglyceride content along with egg proximate analysis, minerals (Calcium, phosphorus) and total phenols were examined. The yolk color was compared to the 15 bands of the DSM yolk color fan strip (Galobart *et al*., 2004). To assess the egg yolk cholesterol and triglycerides, the egg yolk was first completely separated from albumen, and then yolk lipids were extracted using the procedure described by Folch *et al.* (1957). The extracted yolk's cholesterol content was then determined using Erba diagnostic kit by colorimetric technique at 560 nm, and egg triglycerides were determined by using GPO-trinder, endpoint assay method at 505 nm wavelength in the spectrophotometer as described by Fossati (1969).

Statistical Methods

The data obtained from the experiment were analyzed statistically using one way analysis of variance (ANOVA) using SPSS software (IBM SPSS Statistics 20) as per the method of Snedecor and Cochran (1994). Duncan's Multiple Range Test was used to compare the differences between treatment means.

Results and Discussion

Proximate Composition

The result of proximate analysis of intervention ingredients is given in Table 1. Higher crude protein (21.77%), ether extract (47.99%) and glucosinolates (151.28 µmole/gram) were found in yellow mustard seed, while mango leaves were rich in crude fibre (19.5%), total phenol (87.1 mg GAE/g), Ash (12.00), calcium (2.13%) and phosphorus (0.123%). Our proximate analysis of mustard seed powder and mango leaves powder corroborates with previous reports of Aletor and Adegoke (2018)**,** Abel *et al. (*2018). Aletor and Adegoke (2018) reported 23.11% crude protein content in yellow mustard seeds. The aqueous extract of *M.indica* leaves contains 86.2 µg GAE/mg extract (Gazwi and Mahmoud, 2019)-

Proximate composition of experimental diets is depicted in Table 2. The inclusion of yellow mustard seed powder (0.5%) and a combination of mango leaf powder (0.25%) with yellow mustard seed powder (0.25%) in T_2 and T_3

Table 1: Proximate composition of Mango leaf powder and Mustard seed powder (on % dry matter basis)

Particulars	*Mango leaf powder*	*Mustard seed powder*
Dry matter	48.85	97.11
Crude protein	10.5	21.77
Ether extract	5.98	47.99
Crude fibre	19.5	9.64
Ash	12.00	4.0
Nitrogen free extract	52.02	16.6
Calcium	2.13	0.73
Phosphorus	0.123	0.09
Glucosinolate (µmole/g)	-	151.28
Total phenol (mgGAE/g)	87.1	21.86

slightly affected the nutritional composition of treatment diets. Non-significant differences were observed in dry matter content among all the treatment groups. The CP % of T_2 group was significantly higher ($P \leq 0.05$) than T_1 group, while non-significant differences ($p \geq 0.05$) were observed between T_1 and T_3; T_2 and T_3. The higher CP and EE content of layer diets in T_2 group may be due to the incorporation of yellow mustard seed, which is a good source of protein and fat. The EE % of T_2 group differed significantly ($P \leq 0.05$) from T_1, and T_3 group, while non-significant differences ($p \geq 0.05$) were observed among T_1 and T_3. Non-significant differences ($P \geq 0.05$) were observed in crude fibre content, ash, calcium and phosphorus content among all the treatment groups. The NFE % of T_1 group differed significantly ($p \leq 0.05$) from T_2 group. Non-significant differences ($P \geq 0.05$) were observed between T_1 and T_3. The glucosinolate content of T_2 group was significantly higher ($P \leq 0.05$) compared to T_3 group. Non-significant difference ($p \geq 0.05$) was observed in total phenol content among all treatment groups.

Production Performance

The production parameters on inclusion of yellow mustard seed powder in layer diets are depicted in Table 3. There is significant decrease ($P \leq 0.05$) in egg production on incorporation of mustard seed powder (T_2) and in combination (T_3) compared to control group (T_1). These results agree with the findings of Englmaierova and Skrivan (2013) and Cheva-Isarakul *et al.* (2001). Decreased feed intake in T_2 group caused lower intake of nutrients (protein, lysine, methionine), particularly metabolizable energy, which might be due to toxic effect of an alkaloid amine (sinapine) on feed intake or inferior metabolism owing to glucosinolates and its derivatives. There was significant decrease ($p \leq 0.05$) in feed intake in T_2 group compared to T_1 group during the experimental period. The decrease in feed intake in mustard seed powder incorporated group might be due to toxic effect of glucosinolate on feed intake (Cheva-Isarakul *et al.*, 2001). Englmaierova and Skrivan (2013) also reported a decrease in feed intake due to mustard meal supplementation in layers. There was significant ($p \leq 0.01$) increase in FCR in yellow mustard seed powder supplemented group (T_2). Our results agree with Aka-Tanimo *et al*.(2020), who reported that mango leaf meal @ 5% increases feed conversion ratio in broilers, but high level of inclusion (7.5%,10%) decreases FCR in broilers. Englmaierova and Skrivan (2013) have also reported a decrease in FCR due to mustard meal supplementation in layers.

The body weight change during entire experimental period is depicted in Table 3. Non significant decrease ($p \leq 0.01$) was observed in overall average body weight in mustard seed powder supplemented group compared to control group but significant increase in body weight of group T_3 birds fed with a combination of mustard seed powder and mango leaf powder. Cheva-Isarakul *et al.* (2001) reported that with the increased mustard meal, there was a significant decrease ($p \leq 0.05$) in the body weight gain in Isa-brown laying hens. An increase in body weight on supplementation of mango leaf extract has been reported by Zhang *et al.* (2014) in broilers.

Table 2: Chemical composition of diet (on % DM basis) fed to experimental laying hens

Particulars	T_1	T_2	T_3
DM%	90.59 ± 0.24	90.14 ± 0.188	90.27 ± 0.28
CP%*	18.03^{b} ± 0.01	18.28^{a} ± 0.06	18.10^{ab} ± 0.05
EE%*	2.52^{b} ± 0.06	2.84^{a} ± 0.04	2.61^{b} ± 0.06
CF%	5.18 ± 0.05	5.22±0.04	5.25 ± 0.02
Ash%	16.49 ± 0.17	16.53±0.17	16.62 ± 0.18
NFE%*	57.76^{a} ± 0.12	57.12^{b}±0.16	57.40^{ab} ± 0.22
Ca%	3.83± 0.14	3.91 ± 0.05	3.92 ± 0.03
P%	0.73 ± 0.02	0.78 ± 0.005	0.75 ± 0.01
Glucosinolate(µmol/g)*	0	7.34^{a} ± 0.6	5.32^{b} ± 0.53
Total phenols (mgGAE/g)	4.006±0.006	4.01±0.005	4.026±0.013

Mean ± S.E values bearing different superscript (a, b, c) in a row differ significantly ($P \leq 0.05$)*

Table 3: Average production performance of laying hens during experimental period

Production Parameters	T_1	T_2	T_3
Egg Production (%)	43.58^{a}± 0.39	39.13^{c}±0.49	40.73^{b}±0.61
Feed Intake(g)	88.95^{a}±0.29	85.54^{b}±0.12	87.87^{ab}±1.32
FCR(Kg/dozen egg)	3.00^{c}±0.04	3.5^{a}±0.03	3.36^{b}±0.02
Body weight(g)	1296.99^{b}±4.41	1291.81^{b}±3.77	1319.47^{a}±4.35

Mean ± S.E values bearing different superscript (a, b, c) in a row differ significantly ($P \leq 0.05$)*

Nutrient Utilization

Table 4 reveals that incorporating yellow mustard seed powder with/without mango leaf powder affects the metabolizability of nutrients. Highly significant differences ($p \leq 0.01$) were found among treatment groups in dry matter utilization, while significant differences ($p \leq 0.05$) were noted in crude protein and organic matter metabolizability among treatments. No significant difference was found in ether extract utilization among treatment groups T_1, T_2 and T_3. Bell *et al.* (1984) have reported that feed utilization efficiency (dry matter and crude protein utilization) was poor in pigs fed mustard meal as the only protein supplement. Mango leaves are a rich source of minerals since they have a high percentage of ash content and crude protein (Princwill-Ogbonna *et al.*, 2019; Jhaumeer *et al.*, 2018). This might be responsible for the increase in nutrient digestibility in group fed with a combination of yellow mustard seed powder and mango leaf powder.

Egg Quality Traits

The average egg weight (Table 5) differed significantly ($p \leq 0.01$) among the treatment groups and was lowest in T_2 (53.42 g) group. These results agree with Englmaierova and Skrivan (2013) and Cheva-Isarakul *et al.* (2001).Shape index

Table 4: Metabolizability of nutrients in laying hens fed diets supplemented with yellow mustard seed powder with/without mango leaf powder.

Parameter	*T_1*	*T_2*	*T_3*
DM (%) **	$59.54^b \pm 0.31$	$55.45^c \pm 0.77$	$63.16^a \pm 0.58$
CP (%)*	$71.46^a \pm 0.57$	$69.58^b \pm 0.33$	$71.13^a \pm 0.33$
EE (%)	61.37 ± 0.64	61.38 ± 0.34	60.38 ± 0.31
Organic matter (%)*	$66.43^b \pm 0.08$	$63.51^c \pm 0.21$	$68.45^a \pm 0.11$

Mean ± S.E values bearing different superscript (a, b, c) in a row differ significantly ($P \leq 0.05$)*and ($P \leq 0.01$) **

Table 5: Egg quality in laying hens fed diets supplemented with yellow mustard seed powder with/without mango leaf powder

	Treatments		
Group	*T_1*	*T_2*	*T_3*
Egg wt. (g)**	$55.16^a \pm 0.12$	$53.42^b \pm 0.24$	$54.93^a \pm 0.07$
Shape index*	$74.44^a \pm 0.35$	$73.61^b \pm 0.27$	$74.39^a \pm 0.29$
Shell wt. (g)	5.28 ± 0.1	5.04 ± 0.02	5.29 ± 0.1
Shell thickness (mm)*	$0.34^a \pm 0.005$	$0.32^b \pm 0.005$	$0.33^b \pm 0.006$
Yolk wt. (g)	15.16 ± 0.57	15.04 ± 1.04	15.08 ± 1.25
Albumen wt. (g)	34.71 ± 0.20	33.33 ± 0.57	34.71 ± 0.56
Albumen height (mm)	6.39 ± 0.57	6.14 ± 0.57	6.35 ± 0.84
Yolk Index	44.45 ± 0.57	44.42 ± 0.49	44.41 ± 0.57
Haugh unit	81.15 ± 0.57	80.03 ± 0.57	80.82 ± 0.55
Yolk colour	5.333 ± 0.33	5.666 ± 0.33	5.333 ± 0.33

Mean ± S.E values bearing different superscript (a, b, c) in a row differ significantly ($P \leq 0.05$)*, ($P \leq 0.01$)**

Table 6: Average values of Egg composition in laying hens fed diets supplemented with yellow mustard seed powder with/without mango leaf powder

	Treatments		
Parameters	*T1*	*T2*	*T3*
DM (%)	25.48 ± 0.37	25.36 ± 0.70	25.05 ± 0.40
EE (%)*	$42.66^a \pm 0.44$	$42.33^a \pm 0.44$	$40.20^b \pm 0.11$
CP (%)	45.40 ± 0.31	45.35 ± 0.27	45.15 ± 0.04
Ash (%)	4.03 ± 0.03	4.16 ± 0.09	4.10 ± 0.04
NFE (%)**	$7.89^b \pm 0.32$	$8.15^b \pm 0.37$	$10.54^a \pm 0.10$
Ca (%)*	$0.13^c \pm 0.03$	$0.22^b \pm 0.01$	$0.26^a \pm 0.02$
P (%)*	$0.620^c \pm 0.005$	$0.650^a \pm 0.005$	$0.630^b \pm 0.005$
Cholesterol (mg/g yolk)	13.52 ± 0.061	13.51 ± 0.058	13.50 ± 0.057
Triglyceride (mg/g yolk)*	$191.41^a \pm 0.33$	$190.37^b \pm 0.25$	$189.45^b \pm 0.28$
Total phenol (mg GAE/g)	1.573 ± 0.008	1.573 ± 0.012	1.573 ± 0.008

Mean ± S.E values bearing different superscript (a, b, c) in a row differ significantly ($P \leq 0.05$)*, ($P \leq 0.01$)**

and shell thickness of eggs differed significantly ($P \leq 0.05$) among treatments while shell weight (gm), egg albumen quality parameters such as albumen height, albumen weight, yolk weight, yolk index, yolk colour, yolk cholesterol (Table 5) and Haugh unit did not differ significantly. The present findings are in corroboration with Englmaierova and Skrivan (2013), who reported a decrease in yolk weight albumen height, haugh unit due to mustard meal supplementation @ 10 g/kg in layers. Contrary to our results, Englmaierova and Skrivan (2013) reported increase in yolk color on the inclusion of mustard seed meal @10 g/kg in diet of ISA Brown laying hens. However, the egg yolk triglycerides were significantly ($p < 0.05$) reduced in T_2 (190.37mg/g) and T_3 (189.45mg/g) groups compared to T_1 (191.41 mg/g) group.

The proximate Egg Composition is depicted in Table 6. Data reveals significant differences ($p \leq 0.05$) in egg Ether Extract%, Ca%, P% of different treatment groups but highly significant differences ($P \leq 0.01$) in NFE%. Non-significant difference ($P \geq 0.05$) was found in Dry Matter %, Crude Protein %, Ash% and Total phenol (mg GAE/g) among all treatment groups.

Conclusion

It may be concluded that the incorporation of yellow mustard seed powder affects the production performance and egg quality of the laying birds, which might be due to high glucosinolate content (151.28 µmole/g) in yellow mustard seed powder.

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ANNOUNCEMENT: SVSBT-NS-2022

IX Annual Convention and National Seminar of SVSBT

The ***IX Annual Convention*** and ***National Seminar*** of The Society for Veterinary Science & Biotechnology ***(SVSBT) on "Recent Biotechnological Advances in Health and Management to Augment Productivity of Livestock and Poultry"*** will be **organized at Ramayanpatti, Tirunelveli - 627 358, Tamil Nadu, during September 22-24, 2022** (Thursday, Friday & Saturday) by Veterinary College & Research Institute, Tirunelveli - 627 358, TANUVAS, (TN). The detailed Brochure cum Invitation showing Theme Areas/ Sessions, Registration Fee, Bank Details for online payment and deadlines, etc. has been floated on the Whats Apps and e-mails. Accordingly, the organizing committee of ***SVSBT NS-2022 invites abstracts*** of original and quality research work on theme areas of seminar limited to 250 words by e-mail on svsbttnns2022@gmail.com or mopandian69@gmail.com latest by 30th August, 2022 for inclusion in the Souvenir cum Compendium to be published on the occasion.

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