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Effect of Feeding Bio-fortified Maize on Performance and Slaughter Parameters in Vanaraja Birds

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ABSTRACT

Background: The normal maize contains high zein fraction and devoid of lysine and tryptophan thus making lysine as second limiting amino acid in it. The opaque-2 and floury-2 mutants produce higher levels of lysine and tryptophan. Through plant breeding programme, bio-fortified maize (Provitamin-A enriched) is being produced. Therefore, the study was conducted to determine the effect feeding different bio-fortified maize based diets in Vanaraja birds.

Methods: The experiment was conducted during January to April 2018 at ICAR-Directorate of Poultry Research. For the purpose, 175 day old chicks were randomly divided into 5 dietary groups each having 7 replicates with 5 birds each. Five experimental diets were formulated to contain normal maize (Diet 1), Vivek Hybrid 9 (Diet 2), APQH9 (Diet 3), Vivek QPM 9 (Diet 4) and white maize (Diet 5). The experimental diets fed *ad libitum* to all the chicks up to 6 weeks (nursery phase) and recorded performance parameters.

Result: Improved feed efficiency was recorded in the group fed diet with APQH9 (Diet 3) compared to other experimental diets. The decrease in abdominal fat and increased breast muscle among the birds fed diet contained Vivek QPM 9 (Diet 4) and APQH9 (Diet 3) was recorded in comparison to other dietary groups. Hence, it is concluded that the birds fed QPM and QPM + Provit A showed an improved feed efficiency, reduced abdominal fat and increased breast muscle in Vanaraja birds during nursery phase.

Key words: Biofortified maize, Performance, Vanaraja chickens.

INTRODUCTION

Maize is mainly used as a source of energy in the diet of poultry. Maize is the preferred grain for computing poultry diets due to its high energy, low fibre, presence of pigments and essential fatty acids. The normal maize contains large zein fraction and a protein devoid of lysine and tryptophan (Prasanna *et al*., 2001). Methionine is the first limiting amino acid in practical diets of poultry, followed by lysine, threonine and tryptophan (Liu *et al*. 2004). Presently, these amino acids are supplemented through external sources, mostly synthetic amino acids in poultry diet. To minimize the synthetic amino acids supplementation in the diet of poultry, maize breeding program for improving protein quality in maize with the discovery of mutants, such as opaque-2 (Mertz *et al.,* 1964) and floury-2 (Nelson *et al.,* 1965) have paid attention of researchers. These mutants produce higher levels of lysine and other desired nutrients and referred to as bio-fortified maize.

Novel breeding strategies have been developed to enhance carotenoid levels in Maize (Zhu *et al.,* 2008; Bai *et al.,* 2011; Farré *et al.,* 2014), as maize lacks carotenoids in the endosperm due to the absence of the enzyme phytoene synthase. It has been reported that the high-carotenoid maize is an alternative to colour additives in poultry diet (Gómez *et al.,* 2017).

The increased performance and anti-oxidant parameters in broiler chicken is reported by Rajasekhar *et al.* (2020) among the groups fed bio-fortified maize and alternate protein sources. It is hypothesized that the use of bio-fortified maize (high lysine and carotenoid) will enable feed manufacturers and other stakeholder to produce balanced poultry feeds with minimal supplementation of costly synthetic nutrients. Therefore, the present study was carried out to determine the effect of feeding different nutrient specific bio-fortified maize on performance and slaughter parameters in Vanaraja birds during nursery phase.

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MATERIALS AND METHODS

The experiment was conducted during January to April 2018 at ICAR-Directorate of Poultry Research, Hyderabad,

Telangana. A total of 175 day old chicks were randomly divided into 5 dietary groups each having 7 replicates with 5 birds. Five experimental diets were formulated to contain normal maize (Diet 1), Vivek Hybrid 9; procured ICAR-IARI, New Delhi (Diet 2), APQH9; procured form VPKAS, Almora (QPM +Pro-A; Diet 3), Vivek QPM 9; procured form VPKAS, Almora (QPM; Diet 4) and white maize; Birsa Agricultural University, Ranchi (WM; Table 1). On day 1, Vanaraja birds were wing-banded and housed in wire-floored stainless steel battery brooders. The brooder temperature was maintained at 35±0.5°C until 7 days of age and gradually decreased to 27°C by 21 days of age, after which chicks were maintained at room temperature (20 to 28°C). Birds were vaccinated against Newcastle (7th and 28th day) and infectious bursal diseases (15th day). The content of lysine was 0.98% in Diet 3 and Diet 4 without synthetic lysine supplementation and other diets (Diet 1, 2 and 5) lysine content was 1.15% with synthetic lysine supplementation. The body weight (BW) gain (BWG) and feed intake (FI) were recorded at weekly interval. Each diet was allotted randomly to seven replicates and fed *ad libitum* from 1 to 42 days of age.

BWG and FI were recorded at weekly interval up to 42 days of age and feed efficiency per pen was calculated as FI per unit BWG. One bird from each replicate weighing nearer to the mean BW of the respective group was selected at end of the experiment and slaughtered by cervical dislocation to study the carcass traits. The ready to cook yield (RTC) (g/kg) and relative weight of breast and abdominal fat were recorded and expressed as percent of pre slaughter live weigh.

Statistical analysis

The variations in data of different parameters were analyzed using the general linear model procedure of SAS version 9.2 (2008; SAS Institute Inc., Cary, North Carolina, USA). The model included different dietary treatments as source of variation. Treatment means were compared using Tukey's test. Orthogonal helmert contrast test was performed using multivariate general linear model procedure where dietary treatments were taken as fixed factor and different parameters were taken as dependent variables.

RESULTS AND DISCUSSION

Diets with different varieties of bio-fortified maize (Vivke hyb 9, APQH9 and Vivek QPM 9) did not affect the body weight gain in the present experiment. However, significantly improved (P<0.05) FCR was recorded in the group fed Diet 3 (APQH9) compared to those fed other diets (Table 2). The lysine content of APQH9 and QPM was 51.45% and 62.24% higher compared to normal maize, respectively. The better (P<0.01) FCR was recorded during early period of experiment compared to towards end of the experiment. The interaction of time and the dietary treatment showed significant effect (P<0.05) on FCR in the present experiment. Contrast analysis revealed significant affect (P<0.01) between Diet 4 (QPM 9) *Vs* Diet 1, Diet 2 and Diet 3. The earlier studies have also reported that the BWG did not differ among the groups fed diet with QPM and normal maize based diets (Rajasekhar *et al.,* 2020). Contrary, it has been reported that the feeding of QPM-based diets improve BWG and FCR in broiler chickens (Panda *et al.,* 2013). The improved FCR among the groups supplemented QPM and QPM + Pro-A might be due to the higher content of lysine and Pro A (Gómez *et al.,* 2017), which could have enhanced nutrient utilization (Prasanna *et al.,* 2001; Panda *et al.,* 2013; Rajasekhar *et al.,* 2020) and feed efficiency. Further, QPM has less leucine and isoleucine and higher lysine compared to normal maize (Rajasekhar *et al.,* 2020), which might have contributed to higher utilization of protein and increased feed efficiency.

The RTC and relative weights of breast muscle, liver, gizzard, spleen, heart and bursa did not differ (P>0.05) with the dietary treatments. However, higher (P<0.01) breast muscle weight was recorded among the groups fed Diet 3 (APQH9) and Diet 4 (QPM) compared to other diets. Similarly, decreased (P<0.05) abdominal fat was recorded among the groups fed Diet 3 (APQH9) and Diet 4 (QPM) compared to other diets in the present study (Table 3). The excessive abdominal fat is an unfavorable trait (Zhou *et al.,* 2006) and it is considered to be waste of dietary energy, which also reduces the carcass yield and affects consumer acceptance (Emmerson, 1997; Fouad and El-Senousey, 2014). Similarly, abdominal fat accumulation negatively affects the reproductive performance (Xing *et al*., 2009) of laying birds. Rosebrough *et al.* (2011) reported that feeding

Table 1: Ingredient and chemical composition of basal diet.

Ingredients composition	kg/100 kg
Maize	61.8
Soybean meal 45	30.8
De-oiled rice bran	3.08
Di-calcium phosphate	1.62
Lime stone powder	1.72
Salt	0.38
DL-Methionine	0.19
L-Lysine HCL	0.11
Premix	0.31
Nutrients composition	
M.E (kcal/kg)	2800
Protein (%)	20.0
Lysine (%)*	1.15
Methionine (%)	0.50
Calcium (%)	0.94
Available phosphorus (%)	0.40
Threonine (%)	0.80

Normal Maize (Diet 1), Vivek Hyb 9 (Diet 2), APQH9 (Diet 3), Vivek QPM 9 (Diet 4) and White Maize (Diet 5). The lysine content of normal maize is 0.241%, Vivek Hyb 9 is 0.249%, APQH9 is 0.365%, Vivek QPM 9 is 0.391 and white maize is 0.253%.

*Content of lysine was 0.98% in Diet 3 and Diet 4 without synthetic lysine supplementation.

Table 2: Effect of feeding different varieties of maize on performance in Vanaraja birds during nursery phase.

Treatments	Time						Overall	
	1 week		3 week		6 week			
	BWG (g)	FCR	BWG (g)	FCR	BWG (g)	FCR	BWG (g)	FCR
Diet 1	49.36	1.693	205.3	2.023	529.7	2.181	261.5	1.960^{ab}
Diet 2	49.33	1.770	213.0	1.979	586.9	2.202	283.1	1.995^{ab}
Diet 3	50.40	1.641	210.6	1.980	583.4	2.034	281.5	1.881^{b}
Diet 4	43.93	1.978	186.6	2.182	584.8	2.131	271.8	2.092^{a}
Diet 5	43.48	1.862	191.4	2.096	563.6	2.177	266.2	2.042^{ab}
SEM	1.22	0.440	4.98	0.02	9.93	0.02	10.6	0.06
P value								
Treatment							0.53	0.03
Time							0.01	0.01
Treatment × Time							0.24	0.05
Contrast (Difference) overall BWG and FCR								
Diet 2 vs Diet 1							0.15	0.58
Diet 3 vs Diet 1 and Diet 2							0.48	0.09
Diet 4 vs Diet 1, Diet 2 and Diet 3							0.77	0.01
Diet 5 vs Diet 1, Diet 2, Diet 3 and Diet 4							0.48	0.24

Normal Maize (Diet 1), Vivek Hyb 9 (Diet 2), APQH9 (Diet 3), Vivek QPM 9 (Diet 4) and White Maize (Diet 5). FCR (Feed intake/Body weight gain). ^{ab} Means having common superscript in a column don't vary significantly (P>0.05).

Table 3: Effect of feeding different varieties of maize on slaughter variables in Vanaraja birds (g/kg live weight).

	RTC	Breast	Liver	Ab. fat	Gizzard	Spleen	Heart	Bursa
Diet 1	760.4	152^{c}	24.6	6.10^{abc}	24.8	1.90	5.60	1.54
Diet 2	828.8	168^{abc}	25.9	7.60^{ab}	26.9	3.16	5.88	1.60
Diet 3	844.6	195^{ab}	27.8	3.80^{bc}	29.4	2.80	6.30	1.38
Diet 4	825.2	200^{a}	23.5	2.70^{c}	24.8	2.56	6.16	1.08
Diet 5	877.3	166^{bc}	31.6	8.08^{a}	32.3	2.86	12.00	1.92
SEM	23.0	4.9	1.5	0.69	1.6	0.20	1.18	0.16
P value	0.6	0.01	0.5	0.03	0.5	0.38	0.41	0.63

Normal Maize (Diet 1), Vivek Hyb 9 (Diet 2), APQH9 (Diet 3), Vivek QPM 9 (Diet 4) and White Maize (Diet 5).
^{abc} Means having common superscript in a column don't vary significantly (P>0.05).

chickens with diet containing high CP level suppresses the mRNA expression of hepatic malic enzyme, acetyl coenzyme carboxylase and fatty acid synthase in a comparison of low-protein diets thereby supresses the fat synthesis in the liver. Dietary protein level affected body fat deposition directly. In the present study, bio-fortified maize, especially APQH9 and QPM contained higher lysine compared to the normal maize, which might have resulted in adequate amount of lysine and carotenoids intake that might have supported well for muscle growth and reduced fat deposition. The lysine content of APQH9 and QPM was 51.45% and 62.24% higher compared to normal maize, respectively. The intake and absorption of lysine might be more as it is imbibed in maize grains of APQH9 and QPM. Therefore, it is concluded that the birds fed QPM (Diet 4) and QPM + Pro-A (Diet 3) showed an improved feed efficiency and reduced abdominal fat and increased breast muscle in Vanaraja birds during nursery phase.

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