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EFFECT OF INCLUSION OF CORN GERM MEAL IN DIETS OF COLORED (RAJA-II) BROILERS WITH PHYTASE ENZYME SUPPLEMENTATION

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ABSTRACT
An experiment was conducted with an objective to study the growth performance of colored broiler chicken fed with corn germ meal (CGM) based diets and to access effect of supplementation of phytase enzyme in CGM based diets on production performance. Eight dietary treatments were prepared by partly replacing maize and soya bean meal (SBM) with 0, 15, 20 and 25% of CGM with put and without phytase enzyme (conc. 2500 IU/g) supplementation at 0.05 percent. Body weight gain, feed intake FCR and livability were estimated for every week and also cumulatively. Cumulative body weight gain of birds ranged from 1369 to 1202 gm differing significantly ($p<0.05$) between 0% CGM groups without and with phytase supplementation but not in other groups. Feed consumption, FCR and livability were not differing significantly ($p>0.05$). The production performance in terms of both performance index scores (PIS) and economic index score (EIS) were ranging from 129.4 (0% CGM with phytase) to162.5 (0% CGM without phytase) for PIS and 6.653 (25% CGM without phytase) to 8.687 (0% CGM without phytase) for EIS values. Results indicate that CGM can be included in the diets of colored broilers without or with phytase enzyme supplementation up to 25 percent level.

INTRODUCTION

Poultry feed accounts for about 60-70 percent of the total cost of production which is one of the most serious challenges for the industry. Cereal by-products and oilseed residues usually constitute about 50 percent of poultry diet. Corn germ meal (CGM) is a byproduct from corn industry obtained after extraction of corn oil and has nutritional characters (with medium energy and protein) for inclusion in poultry feeds(Loy and Wright, 2003). The proximate composition of the CGM is not constant and is changing depending on various factors like area of cultivation, method of oil extraction and variety of corn used etc. The proximate composition of full fat and defatted CGM reported by various researchers are presented in Table No. I.

Brito *et al.* (2005) carried out two experiments to estimate the performance of broilers fed on increasing levels of corn germ meal(CGM) in the diets and recommended inclusion levels of CGM were 21.9 and 22.5 per cent from 8 to 21 days and from 22 to 38 days, respectively. Brunelli *et al.* (2006) conducted an experiment with increasing level of inclusion of defatted CGM in broiler diets up to 20 percent level and concluded that defatted CGM in broiler can be fed up to 20 percent level in broiler diets without affecting productive performance and carcass characteristics of birds. Brito *et al.* (2009) evaluated the performance and egg quality of laying hens in second production cycle (78 to 90 weeks) consuming corn germ by replacing corn in the diet. They recommend a level up to 25% of substitution of corn with corn germ which was 16% of corn germ in the total diet for laying hens in second production cycle.

The high crude fibre (CF) content and high phyate phosphorus content of CGM (Graf and Eaton, 1984) limits its use at higher levels in poultry diets. Phosphorus in phytate form interferes with nutritional value, reducing the bioavailability of other minerals, digestive enzymes and proteins of the ration, which affects the performance of birds when incorporated in poultry diets (Ravindran *et al.*, 1999). Jadhav *et al.* (2011) conducted a study to evaluate the effect of phytase supplementation on growth and nutrient balance in chicken fed diets containing sunflower meal (SFM) as a partial replacement for SBM at two different levels of dicalcium phosphate (DCP) with or without exogenous phytase enzyme and concluded that 50 percent of DCP can be substituted by limestone with phytase incorporation without any adverse effects on growth and performance of broilers to make broiler feeding comparatively cheaper.Deepa *et al.* (2011) studied the effect of phytase and citric acid on growth performance, phosphorus, calcium and nitrogen retention in broilers fed with low levels of available phosphorus (P_{AV}).The results revealed increase in weight gain and feed intake of broilers fed diets with phytase alone and also with phytase plus citric acid supplementation. Pacheco *et al.* (2012) studied the effect of phytic acid present in CGM on feed intake body weight, FCR and blood biochemistry in pigs and concluded that diets containing higher levels of phytic acid (with CGM as ingredient) did not affect the parameters studied. In this regard present work was planned to study the performance of colored broilers fed with different levels of CGM without and with phytase supplementation.

MATERIALS AND METHODS

One day old colored broiler (Raja-II) chicks were randomly distributed (n = 240) into eight treatment groups of 30 birds each (5 replications of 6 birds each). Two hundred and forty one day old colored broiler (Raja-II) chicks were randomly distributed into eight treatment groups of 30 birds each (5 replications of 6 birds each). The birds were reared on wire floor battery raised brooders of single tier system which were kept in well ventilated and hygienic house under standard management conditions. Chicks were vaccinated against Marek's disease at hatchary by subcutaneous route, New Castles Disease (NDV) on 7th day using F1 strain by occular route and against IBD disease on 17th day through drinking water. The rest of manage mental practices like brooding, lighting, and other biosecurity measures were followed uniformly for all the birds during the 42 day experimental period.

The expeller processed CGM was procured from Dharward, Karnataka and tested for the presence of Aflotoxins which are potent hepatotoxic and immunotoxic factors in broiler feeds (Ramdas *et al.*, 2013) at pristine laboratories, Bangalore. Proximate composition, calcium and phosphorus contents of feed ingredients included in the rations and composed treatment diets were analysed (AOAC, 2005) and presented in Table 2 and 3 respectively. As per NRC (1994) standards, practical basal diet comprising of maize, soybean meal was prepared to serve as a control diet (T_1). The treatment diets were prepared by incorporating 15, 20 and 25 per cent of CGM without phytaseenzyme by partly replacing both maize and SBM. All the diets were isonitrogenous and isocaloric. Further, the control and test diets were supplemented with Phytaseenzyme at 0.05 percent (Conc. 2500 IU/g) and by replacing DCP with lime stone powder (LSP) while keeping other ingredients common, resulting in another set of four diets. In these diets the level of phosphorus was lower than the level suggested by NRC 1994. This was done to know the efficiency of CGM as a source of phosphorus with phytase enzyme supplementation. The 42 day experimental period was conveniently divided into three phases each having 14 days viz., 0-14 days pre starter phase, 15-28 days starter phase, 29-42 days finisher phase. The experimental diets were prepared afresh for each use and the dietary formulation was presented in Table III. Body weight gain, feed intake and FCR were calculated phase wise and also cumulatively. The data generated was subjected to statistical analysis (Snedecor and Cochran, 1989) by using two-way ANOVA procedure of SAS 9.1 portable software.

RESULTS AND DISCUSSION

The data pertaining to different parameters of broilers in different treatment groups during the experimental period is presented in Table 4.There was significant difference ($p < 0.05$) in body weight gain during pre starter stage, but no significant ($p > 0.05$) difference in body weight gain during starter, finisher phases and also cumulatively among treatment groups fed diets with different levels of CGM without phytase enzyme supplementation (T_1,T_2, T_3 and T_4). The body weight gain of birds in phytase enzyme supplemented groups with different levels of CGM (T_5, T_6, T_7 and T_8) found to be statistically similar ($p > 0.05$). Enzyme supplementation resulted in significant reduction ($p < 0.05$) in body weight gain in 0 percent CGM fed groups but in groups fed with CGM based diets.

The reduction in body weight gain in T_5 (0% CGM with phytase) group is may be due to the low level of available phosphorus as DCP in T_1 (0% CGM without phytase) diet is replaced with LSP in T_5, where as in treatment diets containing CGM in their diet the amount of phosphorus reduced by the replacement of DCP with LSP was supplied by the action of phytase enzyme on phytate phosphorus present in CGM resulting in non significance in body weight gain. Similar results were obtained by Brito *et al.* (2005) with respect to CGM level of inclusion in the diets. However, Brunelli *et al.* (2006) reported significant ($p < 0.01$) increase in weight gain of birds with increasing level of defatted CGM inclusion in the diets.

Table 1: Percent chemical composition of defatted and full fat CGM

Reference	Type of CGM	DM	TA	CP	EE	CF	NDF	ADF	Ca	P	MEK Cal/ Kg
Gupta *et al* 1998	defatted	-	-	24.69	05.68	7.56	-	-	-	-	-
Moreira *et al.,* 2002	defatted	91.14	04.53	10.20	01.27	-	-	-	-	-	2949
Mendes *et al.,* 2006	defatted	89.67	03.90	12.40	01.60	-	37.60	07.30	-	-	3000
Brunelli *et al.,* 2006	defatted	89.44	06.44	09.81	00.60	05.29	-	-	-	-	2413
Beran *et al.,* 2007	defatted	88.03	07.35	10.79	00.20	-	-	-	-	-	-
Weber *et al.,* 2010	defatted	-	02.42	21.00	02.12	09.53	54.41	11.13	0.03	1.79	-
Anderson *et al.,*2012	defatted	89.13	02.70	23.64	2.38	10.69	61.05	12.49	0.04	0.65	-
Brito *et al.,* 2005	Full fat	90.00	-	10.88	09.32	05.14	-	-	0.02	0.07	3350
Ramos *et al.,* 2007	Full fat	88.28	02.62	10.13	09.96	02.18	30.25	09.09	0.02	0.41	3019
Calderano *et al.,* 2010	Full fat	90.50	02.74	10.39	12.09	06.42	38.01	08.35	0.04	0.43	2832
Albuquerque *et al.,* 2014	Full fat	96.39	01.87	11.48	49.48	-	-	-	-	-	-

Table 2: Chemical composition of feed ingredients (% DM basis)

Ingredient	Moisture	CP	EE	CF	TA	NFE	Ca	P
Maize	10.76	8.75	4.11	2.86	2.08	71.44	0.015	0.24
SBM	10.66	48.54	1.51	7.19	3.09	29.01	0.322	0.687
CGM	8.603	21.13	10.85	13.56	2.44	43.32	0.345	0.624

Table 3: Composition of experimental diets

Ingredient	Pre starter diet T_1	T_2	T_3	T_4	T_5	T_6	T_7	T_8
Corn	56.0	46.6	43.9	41.0	56.4	47.0	44.3	41.4
SBM	40.3	34.8	32.8	30.5	40.3	34.8	32.8	30.5
CGM	0.0	15.0	20.0	25.0	0.0	15.0	20.0	25.0
Veg oil	-	-	-	-	-	-	-	-
Min.mix[1]	2.70	2.70	2.70	2.70	2.70	2.70	2.70	2.70
DCP	1.00	1.00	1.00	1.00	0.00	0.00	0.00	0.00
LSP	0.00	0.00	0.00	0.00	0.64	0.64	0.64	0.64
DL-meth	0.20	0.10	0.00	0.00	0.20	0.10	0.00	0.00
Phytase[2]	0.00	0.00	0.00	0.00	0.05	0.05	0.05	0.05
Analysed Proximate composition of experimental diets								
DM %	90.03	91.41	91.16	91.57	91.33	90.35	91.45	91.61
OM	85.06	85.29	85.17	84.45	84.91	84.17	86.28	85.84
TA	5.87	6.12	5.99	7.12	6.42	6.18	7.03	6.88
CP	23.34	23.22	23.04	23.19	23.05	22.89	23.08	22.77
EE	3.50	4.06	4.54	5.13	4.02	4.48	5.17	5.77
CF	3.26	5.41	6.12	6.51	3.52	4.87	5.33	6.09
NFE	54.96	52.6	51.47	49.62	54.32	51.93	52.7	51.21
ME[3] (K.cal/kg)	2907	2915	2890	2857	2905	2898	2915	2928

Ingredient	Starter diet T_1	T_2	T_3	T_4	T_5	T_6	T_7	T_8
Corn	60.2	51.1	48.2	42.0	60.6	51.5	48.5	45.5
SBM	36.5	30.	28.5	26.0	40.3	34.8	32.8	30.5
CGM	0.0	15.0	20.0	25.0	0.0	15.0	20.0	25.0
Veg oil	-	-	-	-	-	-	-	-
Min.mix[1]	2.70	2.70	2.70	2.70	2.70	2.70	2.70	2.70
DCP	1.00	1.00	1.00	1.00	0.00	0.00	0.00	0.00
LSP	0.00	0.00	0.00	0.00	0.64	0.64	0.64	0.64
DL-meth	-	-	-	-	-	-	-	-
Phytase[2]	0.00	0.00	0.00	0.00	0.05	0.05	0.05	0.05
Analysed Proximate composition of experimental diets								
DM %	90.41	90.29	90.06	90.33	89.72	89.61	90.19	90.35
OM	83.23	83.43	83.64	84.32	82.4	82.77	83.65	83.97
TA	7.18	6.86	6.42	6.01	7.32	6.34	6.54	6.38
CP	21.27	20.84	21.01	20.39	21.42	21.48	20.75	21.07
EE	2.81	3.85	4.19	4.55	2.98	3.94	4.04	4.31
CF	3.18	5.23	6.08	6.47	3.22	4.87	5.43	6.33
NFE	54.43	53.61	52.2	52.5	53.33	52.34	52.42	51.28
ME[3] (K.cal/kg)	2907	2947	3019	2989	3023	2928	2973	2989

Ingredient	Finisher diet T_1	T_2	T_3	T_4	T_5	T_6	T_7	T_8
Corn	63.2	54.0	50.4	46.7	63.4	54.2	50.6	46.9
SBM	31.5	25.3	23.4	22.0	31.7	25.5	23.6	22.2
CGM	0.0	15.0	20.0	25.00	0.00	15.00	20.00	25.00
Veg oil	1.60	2.00	2.50	2.60	1.60	2.00	2.50	2.60
Min.mix[1]	2.70	2.70	2.70	2.70	2.70	2.70	2.70	2.70
DCP	1.00	1.00	1.00	1.00	0.00	0.00	0.00	0.00
LSP	0.00	0.00	0.00	0.00	0.64	0.64	0.64	0.64
DL-meth	-	-	-	-	-	-	-	-
Phytase[2]	0.00	0.00	0.00	0.00	0.05	0.05	0.05	0.05
Analysed Proximate composition of experimental diets								
DM %	89.68	89.62	89.54	90.15	89.01	89.75	89.31	89.59
OM	84.27	84.30	85.01	85.82	83.25	83.41	84.62	84.21
TA	5.41	5.32	4.53	4.33	5.76	6.34	4.69	5.38
CP	19.54	19.23	18.78	19.01	19.71	19.59	18.34	18.04
EE	4.22	4.77	5.52	6.14	4.51	5.61	6.14	6.51
CF	3.04	4.95	5.83	6.11	3.58	4.66	5.59	6.02
NFE	55.56	55.17	53.96	53.55	54.14	52.15	53.08	52.58
ME[3] (K.cal/kg)	2907	3041	3061	3062	3107	3020	3036	3066

Min. Mix[1]-1 Mineral Mixture: Contains calcium–32%, phosphorus-6%, copper-100 ppm, cobalt-60 ppm, manganese-2700 ppm, iodine-100 ppm, zinc-2600 ppm, iron-0.1%.
Phytase[2]-Commercial phytase enzyme(2500IU/gm) in power form
ME[3]- Calculated value

Contrary to these findings Strighini *et al*. (2009) observed significantly ($p<0.05$) decrease in body weight gain with increasing level of CGM inclusion in diets. These variations in the reports were mainly due to variations in the composition of CGM. The results of enzyme supplemented groups receiving 0 percent CGM (T_5) in their diets with low phosphorus supplemented with phytase enzyme were contradicts with reports of Jadhav *et al*. (2011).

The differences in feed consumption were non- significant ($p>0.05$) during different phases of experiment as well as cumulatively among all treatment groups fed different levels of CGM without (T_1, T_2, T_3 and T_4) and with phytase enzyme in their diets (T_5, T_6, T_7 and T_8). Phytase enzyme supplementation did not result in significant difference in feed consumption (T_1-T_5, T_2-T_6, T_3-T_7 and T_4-T_8). Brito *et al*. (2005) and Brunelli *et al*. (2006) also observed non-significant differences in feed consumption of broiler birds with different levels of CGM. However Brunelli *et al*. (2010) and Albuquerque *et al*. (2014) reported decreased feed intake with increasing level of CGM inclusion in layer diets. Albuquerque *et al*. (2014) reported that the lower feed intake of CGM based diets were due to high fat content of CGM According to Mateos and Sell (1981), fat-rich diets promote slower feed passage rate. Increased fatty acid ingestion activates hormones that slow down peristaltic movements, increasing the time the digesta remains in the digestive system and promoting the perception of satiety thereby reducing feed intake. Bolka (2002) and Bingol*et al*. (2009) also reported non significant results in feed consumption with and without addition of phytase enzyme by keeping P_{av} at low level similar to present study.

The phase wise average FCR values were differing non significantly ($p>0.05$) during all phases and also cumulatively among treatment groups fed increasing levels of CGM in absence of phytase enzyme (T_1, T_2, T_3 and T_4) and also in presence of phytase enzyme (T_5, T_6, T_7 and T_8) during all phases and also cumulatively. The FCR values were differing significantly ($p<0.05$) only between 15 percent CGM fed groups without (T_3) and with phytase enzyme (T_7) in their diets during pre starter stage only and non-significant ($p>0.05$) during grower and finisher phases and also cumulatively when pair comparison (T_1-T_5, T_2-T_6, T_3-T_7 and T_4-T_8) was made. The findings of Brito *et al*. (2005) and Strighini *et al*. (2009) were in agreement with the present study, contrary to this Brunelli *et al*. (2006) observed decreased feed efficiency linearly with linear increase of defatted CGM inclusion in the diets.The PIS value found to be highest in T_1 (162.5) and lowest in T_5 (129.4).The EIS values were computed by considering PIS value and cost of diet per kg ranged from 8.687 (T_1) to 6.635 (T_4). Decrease in EIS values with increasing levels of CGM in the diets was observed in phytase enzyme non supplemented groups. This study reveals that CGM can be included in colored broiler diets upto 25% with and without phytase enzyme supplementation.

REFERENCES

Albuquerque, C. S., Rabello, C. B. V., Santos, M. J. B., Lima, M. B., Silva, E. P., Lima, T. S., Ventura, D. P. and Dutra Jr, W. M. 2014. Chemical composition and metabolizable energy values of corn germ meal obtained by wet milling for layers.*Rev. Bras. Cienc. Avic.* **16(1).**

Table IV: Cumulative body weight gain, feed consumption, FCR ,livability and performance scores of colored (Raja-II) broiler birds under different treatment groups

Cumulative	T_1	T_2	T_3	T_4	T_5	T_6	T_7	T_8	
Body wt gain	1369^{aA}	1359^{aC}	1316^{aD}	1301^{aE}	1202^{xB}	1230^{xC}	1272^{xD}	1273^{xE}	**
Feed consumption	2734	2796	2950	2569	2655	2681	2771	2796	NS
FCR	1.997	2.057	2.241	1.975	2.209	2.180	2.179	2.197	NS
Livability	96.67	96.67	93.33	83.33	96.67	100.0	100.0	93.33	NS
PIS	162.5	156.7	134.5	134.8	129.4	138.8	143.4	132.9	-
EIS	8.687	8.563	7.898	6.635	7.586	7.612	8.350	7.628	-

[ab] Mean values within the row not bearing a common superscript letters differ ($P < 0.05$). (Comparison made among treatment groups fed diets with different levels of CGM without phytase supplementation viz. T_1, T_2, T_3 and T_4); [xy] Mean values within the row not bearing a common superscript letters differ ($P < 0.05$). (Comparison made among treatment groups fed low phosphorus diets with different levels of CGM supplemented with phytase enzyme. viz. T_5, T_6, T_7 and T_8) ; [ABCDEF] Mean values within a row not bearing a common superscript letters differ ($P < 0.05$). (Comparison between treatment groups fed diets with same levels of CGM with out and with phytase supplementation viz. T_1-T_5, T2-T_6, T3-T_7 and T_4-T_8); * Mean values within the same row do not differ

Anderson, P. V., Kerr, B. J. , Weber, T. E., Ziemer, C. J. and Shurson, G. C. 2012. Determination and prediction of digestible and metabolizable energyfrom chemical analysis of corn coproducts fed to finishing pigs. *J. Anim. Sci.* **(90):** 1242-1254.

AOAC 2005. Official Methods of Analysis, *Association of Official Analytical Chemists, Edn.13th.*, Washington, D.C, USA.

Beran, F. H. B., Silva, L. D. F., Ribeiro, E. A., Rocha, M. A. and Ezequiel, J. M. 2007. Evaluation of Intestinal Digestibility of Different Concentrate Feeds Using an in Vitro Three-step Enzymatic Procedure. *Braz. J. Ani. Sci.* **36(1):** 130-137.

Bingol Tugba, N., Akif Karsli, M., Bolat, D. and Levendoglu, T., 2009. Effect of microbial phytase on animal performance, amount of phosphorus excreted and blood parameters in broilers fed with low non-phytate phosphorus diets. *Asian. J. Anim. Vet. Adv.* **4(3):** 160-166.

Brito, A. B., Stringhini, J. H., Cruz, C. P., Xavier, S. A. G., Leandro, N. S. M. and Cafe, M. B. 2005. Effects of corn germ meal on broiler performance and carcass yield. *Arq. Bras. Med. Vet. Zootec.* **57(2):** 241-249BRITO, A.B., STRINGHINI, J.H., XAVIER, S.A.G.

Leandrro, N. S. M. and Mogyca, S. 2009. Performance and egg quality of laying hens after molting (78 to 90 weeks of age) fed corn germ meal. *Braz. J. Ani. Sci.* **38(10):** 1907-1913.

Brito, A. B., Stringhini, J. H., Cruz, C. P., Xavier, S. A. G., Leandro, N. S. M. and Mogyca, S. 2009. Performance and egg quality of laying hens after molting (78 to 90 weeks of age) fed corn germ meal. *Braz. J. Ani. Sci.* **38(10):** 1907-1913.

Brunelli, S. R., Pinheiro, J. W., Da Silva, C. A. and Aparecida, N. 2006. Feeding increasing defatted corn germ meal levels to broiler chickens. *Braz. J. Ani. Sci.* **35(4):** 1349-1358.

Brunelli, Sandra, R., Pinheiro, Waine, J., Fonseca, Nicolao, N. A., Obaalexandre, Da Silva, C. A. 2010. Defatted corn germ meal in diets for laying hens from 28 to 44 weeks of age. *Braz. J. Anim. Sci.* **39(5):** 1068-1073

Calderano, A. A., Gomes, P. C. and Albino, L. S. 2010. Chemical composition of feed stuffs of plant origin for poultry. *Braz. J. Ani. Sci.* **39(2):** 320-326.

Deepa, C., Jeyanthi, G. P. and Chandrashekaran, D. 2011. Effect of phytase and citric acid supplementation on growth performance, phosphorus, calcium and nitrogen retention in broiler chicks fed with low levels of available phosphorus. *Asian. J. Poult. Sci.* **5(1):** 28-34

Graf, E. and Eaton, J. W. 1984. Effects of phytate on mineral bioavailability in mice. *J. Nutr.* **114(7):** 1192-1198.

Gupta, H. O. and Eggum, B. O. 1998. Processing of maize germ oil cake into edible foodgrade meal and evaluation of its protein quality. *Plant Foods for Human Nutrition.* **52:** 1-8.

Jadhav, N. V., Suranagi, M. D., Anjaneya, S. S., Prakashchandra., Mallikarjunappa 2011. Effect of replacing soyabean meal and dicalcium phosphate in diets with alternative ingredients and phytase supplementation on growth and nutrient balances in broiler chicken.*Anim. Nutr. Feed Technol.* **11(2):** 203-210.

Loy, D. D. and Wright, K. N. 2003. Nutritional properties and feeding value of corn and its by-products, Corn Chemistry and Technology. American Association of Cereal Chemists, Inc. St. Paul, MN. pp. 571-603.

Mateos, G. G. and Sell, J. L. 1981. Influence of Fat and Carbohydrate Source on Rate of Food Passage of Semipurified Diets for Laying Hens. *Poultry Science.* **60(9):** 2114-2119.

Mendes, R., Bertocco, E. J. M., Laos, G. R., Nascimento, Virgolio, F. D. and Oliveira, M. A. 2006. Digestion kinetics and efficiency of microbial protein synthesis on beef steers fed sunflower meal and different energy sources. *Braz. J. Ani. Sci.* **35(1).**

Moreira, I., Ribeiro, C. R., Furlan, C. A., Scapinello, C. and Kutschenko, M. 2002. Utilization of defatted corn germ meal on growing-finishing pigs feeding- digestibility and performance. *Braz. J. Ani. Sci.* **31(6).**

National Research Council. 1994. Nutrient Requirements of Poultry. *Edn.*9th.,Natl. Acad. Press, Washington, DC.

Pacheco, G. D., Lozano, A. P., Vinokurovas, S. L., Silva, R. A. M., Dalto, D. B., Agostini, P. S., Westphalen, N., Bridi, A. M. e Silva, C. A. 2012. Defatted corn germ meal associated with phytase in the diet. *Arch. zootec.* **61(3):** 236 -242.

Ramdas, R. P., Balkrishna, K. G. and Govind, G. 2013. Pathological effects of low grade aflotoxicity in broilers. *The Bioscan (Supplement on Toxicology)* **8(3):** 1115-1118.

Ramos, L. N., Teixeira, L. A., Rostango, H. S., Araojo, A. M. and Rodraigues 2007. Metabolizable energy values of feedstuffs to broilers. *Braz. J. Ani. Sci.* **36(5):** 1354-1358.

Ravindran, V., Cabahug, S., Ravindran, G. *et al.* 1999. Influence of Microbial Phytase on Apparent ileal amino acid digestibility of feedstuffs for broiler. *Poult. Sci.* **78(5):** 699-706.

Saxena, H. C. 1999. Broiler industry in the new millennium (Hand book of broiler farmers). *Eds.* Agri. Tech. Associates., Prabath printing works, Pune.

Snedecor, G. W. and Cochran, W. G. 1989. Statistical Methods. *Edn. 6th.*, Oxford and IBH Pub. Co., New Delhi.

Stringhini, J. H., Arantes, U. M., Laboissiere, M., Rodrigues, Pedroso, A. A. and Leandro, S. M. 2009. Performance of broilers fed sorghum and full fat corn germ meal. *R. Bras. Zootec.* **38(12):** 2435-2441

Weber, T. E., Trabue, S. L., Ziemer, C. J. and Kerr, B. J. 2010. Evaluation of elevated dietary corn fiber from corn germ meal in growing female pigs. *J. Anim. Sci.* **88:** 192-201.