ISSN: 0976-3376

Available Online at http://www.journalajst.com

ASIAN JOURNAL OF
SCIENCE AND TECHNOLOGY

Asian Journal of Science and Technology
Vol. 07, Issue, 07, pp.3223-3226, July, 2016

RESEARCH ARTICLE

EFFECT OF DIETARY SUPPLEMENTATION OF NON STARCH POLYSACCHARIDE HYDROLYZING ENZYMES ON PERFORMANCE OF BROILERS REARED ON *SUB-OPTIMAL* DIETS

[*1]Nikam, M.G., [1]Ravinder Reddy, V. [2]Raju, M.V.L.N., [2]Rama Rao, S.V., [1]Kondal Reddy, K. and [1]Narasimha, J.

[1]Department of Poultry Science, College of Veterinary Science, Rajendranagar, Hyderabad, India
[2]Directorate of Poultry Research, Rajendranagar, Hyderabad, India

ARTICLE INFO

Article History:
Received 27th April, 2016
Received in revised form
30th May, 2016
Accepted 21st June, 2016
Published online 30th July, 2016

Key words:

Non starch polysaccharide
Hydrolyzing enzymes,
Lower concentration,
Higher concentration.

ABSTRACT

Three hundred one-day old Ven-Cobb straight run commercial broiler chicks were supplemented with the non starch polysaccharide hydrolyzing enzymes at 1X higher concentration (HC) viz. (xylanase, ß-D-glucanase, cellulase, mannanase and pectinase @ 2400, 4800, 1800, 4800, and 2400 IU/kg respectively. The similar enzyme combination was supplemented @ 4800,9600,3600,9600 and 4800 IU/kg respectively as 2X (HC) to the corn + soybean meal based diets having *sub-optimal* (-100 Kcal) energy levels. Similarly the diets were supplemented with NSP hydrolyzing enzymes at 1X lower concentrations (LC) viz. (xylanase, ß-D-glucanase, cellulase, mannanase and pectinase @ 400, 240, 200, 200, and 400 IU/kg respectively. The same NSP hydrolyzing enzyme combination was supplemented @ 800,480,400,400 and 800 IU/Kg respectively as 2X (LC). The birds were weighed, wing banded and randomly distributed in to six experimental groups, with ten replicates and five birds in each replicate to assess the effect of the NSPHE combination on growth performance of broilers. The NSP hydrolyzing enzyme supplemented diet @ 2X (HC) had shown significantly higher ($P<0.05$) BWG in week wise the feed intake was significantly higher ($P<0.05$) in standard control diet and NSP hydrolyzing enzyme supplemented diet @ 2X (HC) respectively. Supplementation of NSP enzymes had influenced the FCR ($P<0.05$) in broilers when reared on the sub-optimal diets.

INTRODUCTION

The major ingredients in poultry rations consist of cereal and vegetable origin protein sources which contain about 10-75% of non-starch polysaccharides (NSP) Chot (2011). The NSP in cereals form a part of the cell wall structure and in vegetable proteins, especially legumes, play a role as an energy storage material. Chicken having a simple stomach, cannot digest complex nutrients like non-starch polysaccharides (NSP). Supplementation of chicken diet with fiber degrading enzymes is known to enhance utilization of the complex carbohydrate moiety Choct (2006). With the continuous increase in world's population and the decline in its food reserve, a more efficient conversion of by-products, including those rich in NSP, into high quality food is a top priority area of research today. Soybean meal (SBM) is being used as sole protein source in recent years which contains about 20% NSP (Malathi and Devegowda, 2001). Similarly, other major ingredients used in broiler and layer diets *i.e.,* maize and rice bran contains 9 and 25% NSP, respectively (Malathi and Devagowda, 2001) half of which is cellulose Saunders (1986). The NSPs are insoluble (cellulose) and soluble (β-glucose, arabinoxylan, arabinogalactose, xyloglucon etc). The soluble NSPs have the property to immobilize water in its matrix by forming loose gel network which is responsible for increased viscosity, there by depressing the digestibility of fats, proteins and starch. These NSPs impair activity of endogenous enzymes by reducing the contact intensity between nutrients and enzymes, which results in sticky and moist droppings. Use of feed enzymes to improve the nutritive value of poultry diets has become common practice in many countries due to use of feed ingredients containing higher proportion of NSP. Hong *et al.* (2002) found that the use of an enzyme cocktail (Xylanase, amylase and protease) improved the digestibility of corn-soybean based diets in ducks. Using enzymes in poultry diets not only enhance bird performance and feed conversion, but also reduce environmental problems due to reduced concentration of nutrients in excreta. Similarly the other possible benefits are increased accuracy and flexibility in least-cost feed formulation and improved well being of the birds.

***Corresponding author: Nikam, M.G.,**
Department of Poultry Science, College of Veterinary Science, Rajendranagar, Hyderabad, India

MATERIALS AND METHODS

The present experiment was conducted on Three hundred (300) one day- old straight run broiler chicks, randomly allotted to six experimental groups having ten replicates per group and five birds per replicate. The experimental diets were standard control diet (SD), and basal control diet (BD). A total of six experimental diets were formulated and details are presented in (Table 1). The ingredients, nutrient composition of diets had been given in (Table 3) whereas the concentrations of the NSPHE required for the experiment had been given in (Table 2).The chicks were fed the respective diets for a period of 42 days. The chicks were supplemented with the NSP hydrolyzing enzymes viz xylanase, ß-d-glucanase, cellulase, mannase and pectinase at higher concentrations (HC) as well as lowers concentrations (LC) on corn- soybean meal diet with *sub-optimal* levels. These pure enzymes were procured from Advanced Bio- Agrotech Limited, Pune, India. The activity of xylanase, ß-d-glucanase, cellulase, mannase and pectinase was 160000, 200000, 1000000, 200000 IU/g, and 150000 respectively. The birds were weighed, wing banded and randomly distributed in to six experimental groups, with ten replicates and five birds in each replicate (Table 1). All the birds were reared under standard managemental conditions. The details of the NSPHE and ingredient composition for the experiment have been given in (Table 2). The data were subjected to appropriate statistical analysis using Statistical Package for Social Sciences (SPSS) 15th version and comparison of means was tested using Duncans multiple range tests Duncan's (1955).

RESULTS AND DISCUSSION

The performance of commercial straight run broiler chicks fed on various levels of NSPHE to the diet containing corn soybean meal based basal diet (BD) was studied in terms of body weight gain, feed intake and feed conversion ratio.

Table 1. Details of experimental diets broiler experiment supplemented with *sub-optimal* diets

Diet	Dietary group	Metabolizable energy (kcal/kg diet)		
		Pre-starter	Starter	Finisher
I	Standard Control without NSPHE	2950	3050	3150
II	Basal Control (-100 Kcal) without NSPHE	2850	2950	3050
III	Basal + 1X (HC) NSPHE	2850	2950	3050
IV	Basal + 2X (HC) NSPHE	2850	2950	3050
V	Basal + 1X (LC) NSPHE	2850	2950	3050
VI	Basal + 2X (LC) NSPHE	2850	2950	3050

Table 2. Details of the NSP hydrolyzing enzyme concentrations selected for broiler experiment supplemented with *sub-optimal* diets

Higher Combinations (HC) - for diets with corn - soybean meal						
Percentage of Enzyme		Xylanase (IU/kg)	β-D-glucanase (IU/kg)	Cellulase (IU/kg)	Mannanase (IU/kg)	Pectinase (IU/kg)
60%	(1X)	2400	4800	1800	4800	2400
120%	(2X)	4800	9600	3600	9600	4800
Lower combinations (LC) – for diets with corn soybean meal						
200%	(1X)	400	240	200	200	400
400%	(2X)	800	480	400	400	800

Table 3. Ingredient composition of broiler standard control diet and basal diet

Ingredient (g/kg)	Standard control diet			Basal diet		
	Prestarter	Starter	Finisher	Prestarter	Starter	Finisher
Maize	524.48	571.04	623.04	547.97	594.53	623.04
Soybean meal	402.32	372.05	310.51	398.02	346.75	310.51
Oil (veg)	31.32	17.24	28.96	12.08	18.82	28.96
Salt	3.8	3.8	3.8	3.80	3.80	3.80
DL-Methionine	2.040	2.21	1.89	2.04	2.20	1.89
Di-Calcium Phosphate	19.97	17.24	16.17	19.97	17.15	16.17
Shell grit	10.60	11.45	10.89	10.60	11.52	10.89
TM mixture[1]	1.00	1.00	1.00	1.00	1.00	1.00
AB2D3K[2]	0.150	0.150	0.150	0.150	0.150	0.150
B-Complex[3]	0.100	0.100	0.100	0.100	0.100	0.100
Choline Chloride	0.50	0.50	0.50	0.50	0.50	0.50
Toxin Binder	2.0	2.0	2.0	2.0	2.0	2.0
Antibiotic	0.50	0.50	0.50	0.50	0.50	0.50
L-lysine HCL	0.720	0.410	0.00	0.80	0.49	0.00
Coccidiostat	0.50	0.50	0.50	0.50	0.50	0.50
Tylan	0.50	0.50	0.50	0.50	0.50	0.50
Total	1000	1000	1000	1000	1000	1000
Nutrient Composition (calculated)						
ME(kcal/kg)	2950.00	3050.00	3150.00	2850	2950	3050
Protein (%)	23.00	21.00	19.50	23.00	21.00	19.50
Calcium (%)	0.90	0.85	0.80	0.90	0.85	0.80
Available (P) (%)	0.45	0.40	0.38	0.45	0.40	0.38
Lysine (%)	1.36	1.20	1.07	1.36	1.20	1.06
Methionine (%)	0.56	0.55	0.50	0.56	0.55	0.50

[1] Trace mineral provided per kg diet: manganese, 120mg; Zinc, 80mg; Iron, 25mg; Copper, 10mg; Iodine, 1mg; and Selenium, 0.1mg. [2] Vitamin premix provided per kg diet: Vitamin A, 20000IU; Vitamin D_3, 3000IU; Vitamin E, 10mg; Vitamin K,2mg; [3] Riboflavin, 25mg; Vitamin B_1, 1mg; Vitamin B_6, 2mg: vitamin B_{12}, 40mcg and Niacin, 15mg.

The body weight gain was significantly higher (P<0.05) in the standard control diet throughout the three phases of experimental period. The diet supplemented with NSPHE @ 2X (HC) (T_4) did show comparatively better BWG than that of 1X (HC) NSPHE(T_3), 1X (T_5) and 2X (LC) (T_6) NSPHE supplementation .The birds fed with basal control diet did shown poor body weight gains. The NSPHE supplemented at 2X (HC) (T_4) had shown significantly higher (P<0.05) BWG compared with that of basal control and the NSPHE at 1X (HC), 1X and 2X (LC) (T_5 and T_6). Highest BWG was observed in birds fed with standard corn - SBM diet (T_1) throughout the experimental period of 6 weeks (Table 4).

in combination to corn soya based diets varying in nutrient density in broilers and observed that weight gains were on par with positive control diets. (Ramesh and Chandrashakeran, 2011[a]) reported decrease in weight gain with non supplemented NSPHE and level of reduction in nutrient density of the diet. Narasimha *et.al.* (2013[b]) concluded that supplementing *sub-optimal* energy diets with NSP enzymes along with synbiotics and phytase improved body weight gain. Feed intake was significantly higher (P<0.05) when the birds were fed with standard control (T_1) and NSPHE @ 2X (HC) (T_4) compared to birds fed with basal diet (T_2), NSPHE @ 1X (HC) (T_3) , 1X (T_5) and 2X (LC) (T_6) supplemented diet.

Table 4. Effect of supplementation of non starch polysaccharide hydrolyzing enzymes to corn soybean meal basal diets on weekly body weight gain (g) of broilers (1-6 wks of age)

T	Enzymes	1 wk	2 wk	3 wk	4 wk	5 wk	6 wk
T_1(SD)	0	100.2	224.1^a	360.3^a	493.8^a	571.6^a	622.4^a
T_2 (BD)	0	98.7	144.8^d	295.4^b	407.8^c	472.2^c	585.8^b
T_3	BD 1X HC	97.5	172.0^c	318.8^b	454.4^b	507.2^b	597.0^{ab}
T_4	BD 2X HC	102.6	205.4^b	327.0^b	471.0^{ab}	562.0^a	625.4^a
T_5	BD1 X LC	94.8	171.3^c	323.6^b	465.8^{ab}	505.0^b	547.8^c
T_6	BD2 X LC	94.8	167.9^c	293.2^b	459.6^b	521.8^b	589.2^b
SEM		0.96	3.90	5.11	5.05	5.96	5.22
P value		0.117	0.001	0.001	0.003	0.001	0.002

** Values bearing different superscripts within column differ significantly

Table 5. Effect of supplementation of non starch polysaccharide hydrolyzing enzymes to corn soybean meal basal diets on weekly body weight gain (g) of broilers (1-6 wks of age)

T	Enzymes	1 wk	2 wk	3 wk	4 wk	5 wk	6 wk
T_1(SD)	0	134.3^b	328.1^a	583.2^a	865.6^a	1,089.6^a	1,232.6^{bc}
T_2(BD)	0	141.6^a	237.0^d	512.0^d	728.0^d	1,012.0^b	1,312.0^a
T_3	BD +1X HC	143.6^a	264.6^c	544.0^{bc}	769.4^c	988.2^{bc}	1,248.0^b
T_4	BD +2X HC	144.6^a	301.0^b	549.0^b	815.2^b	985.0^{bc}	1,246.0^b
T_5	BD+ 1X LC	140.0^a	264.0^c	532.0^c	790.0^{bc}	988.0^{bc}	1,218.0^{bc}
T_6	BD+ 2X LC	140.4^a	266.4^c	511.0^d	796.2^{bc}	982.0^c	1,198.0^c
SEM		0.81	4.28	3.87	7.15	6.12	7.22
P value		0.002	0.001	0.003	0.004	0.001	0.014

**Values bearing different superscripts within column differ significantly

Table 6. Effect of supplementation of non starch polysaccharide hydrolyzing enzymes to the corn soybean meal basal diets on weekly feed efficiency of broilers (1-6 wks of age)

T	Enzymes	1 wk	2 wk	3 wk	4 wk	5 wk	6 wk
T_1(SD)	0	1.34	1.47	1.63	1.77	1.91^b	1.98^a
T_2 (BD)	0	1.44	1.66	1.75	1.80	2.15^c	2.25^b
T_3	BD + 1X HC	1.48	1.56	1.72	1.70	1.96^b	2.10^a
T_4	BD +2X HC	1.41	1.47	1.68	1.73	1.76^a	2.00^a
T_5	BD +1X LC	1.49	1.55	1.68	1.70	1.96^b	2.23^b
T_6	BD + 2X LC	1.49	1.59	1.75	1.73	1.89^b	2.04^a
SEM		0.021	0.022	0.019	0.016	0.023	0.020
P value		0.054	0.155	0.524	0.686	0.001	0.002

Values bearing different superscripts within a column are significantly (P<0.05) different

The present findings with respect to BWG are in accordance with (Naqui and Nadeem, 2004) who observed significant increase (P<0.05) in weight gain and FCR was observed in chicks fed on ration having 3000 kcal of ME with Kemzyme supplementation compared to low energy group. Song *et al.* (2010) in an experiment conducted with standard energy diet as well as low energy diet supplemented with different NSPHE combinations reported that the average daily gain in treatment groups supplemented with (xylanase +beta –glucanase), (xylanase + β-glucanase+ β-mannose), and (xylanase + β-glucanase + β-mannanase+cellulase, respectively) was comparable to that of normal control group. Cowieson *et al.* (2010) evaluated the effect of various doses of xylanase (8000, 16000 IU/kg) and glucanase (15000, 30000 IU/kg), alone and

The standard control diet (T_1) had shown significantly higher feed intake (P<0.05) compared with rest of the treatments (P<0.05). The basal diet (T_2) showed significantly lower feed intake during pre starter and starter phase, whereas during finisher phase feed intake was the highest (P<0.05) in the basal diet. Birds fed with NSPHE @ 2X (HC) (T_4) had shown significantly higher feed intake (P<0.05) compared to the rest of the diets throughout pre starter and finisher phases. The diets with NSPHE @ 1X (HC), 1X and 2X (LC) showed significantly poor feed intake .Birds fed with NSPHE @ 2X (HC) (T_4) had shown significantly higher feed intake (P<0.05) compared to the rest of the diets throughout pre starter and finisher phases. The diets with NSPHE @ 1X (HC), 1X and 2X (LC) showed significantly poor feed intake (Table 5).

The results are supported by Nadeem *et.al.* (2005) who reported that by supplementing NSP degrading enzymes at higher concentrations 1X and 2X (HC) to low energy diets resulted in higher feed intake during overall period compared to basal corn-soy control. Cowieson *et.al.* (2010) who observed higher feed intake in low energy deficient corn-soy diet ($P<0.01$) supplemented with NSPHE alone or in combinations in broilers compared to standard diet. There were no significant differences in FCR among all the treatment groups during 1 to 4 weeks of age. However, there was a significant difference ($P<0.05$) in FCR during the 5th and 6th week. In the fifth week, birds fed with NSPHE @ 2X (HC) (T_4) had shown ($P<0.05$) better FCR (1.76) in comparison to rest of the dietary treatments. During sixth week, birds receiving the basal diet (T_2) and basal diet with 1X (LC) experienced poor FCR (Table 6). The other treatment groups recorded statistically similar FCR.The FCR was significantly better ($P<0.05$) in the NSPHE @ 2X (HC) (T_4) followed by (T_1, T_6 and T_3). The overall FCR was significantly better ($P<0.05$) in the diet supplemented with NSPHE @ 2X (HC) (T_4) and standard control diet (T_1). The basal diet (T_2) had recorded a poor FCR throughout the experimental period (Table 6). However, the birds receiving diets supplemented with NSPHE @ 1X (HC) (T_3), 1X and 2X (LC) T_5 and T_6 had shown significantly ($P<0.05$) better FCR compared with the treatment T_2. Supplementation of NSP enzymes at 2X (HC) (T_4) influenced the FCR ($P<0.05$) during overall period (0-42) days (Table 6). The findings of this experiment were supported by Song *et al.* (2010) who reported that feed conversion ratio (FCR) of chickens in energy deficient diet was comparable to that of normal control group. Narasimha *et al.* (2013[a]) concluded that FCR improved with addition of NSP enzymes alone or in combination with prebiotics. Narasimha *et al.* (2013[b]) stated that supplementing *sub-optimal* energy diets with NSP enzymes along with synbiotics and phytase improved FCR. Rama Rao *et al.* (2014) reported that inclusion of GM 200g/kg diet with incremental level of enzyme supplements resulted ($P<0.05$) lower FCR. Santhi *et al.* (2014) conducted an experiment to find out the effect of supplementation of exogenous cellulase through feed in turkeys up to eight weeks. The findings of the study indicated significant improvement in feed efficiency in the enzyme supplemented groups.

Conclusion

The non starch polysaccharide hydrolyzing enzyme (NSPHE) combination @ 2X (HC) viz. (xylanase, ß-D-glucanase, cellulase, mannanase and pectinase @ 4800,9600,3600,9600 and 4800 IU/kg respectively to the corn + soybean meal based diets having *sub-optimal* (-100 Kcal) energy levels have influenced the BWG, FI and FCR in broilers. ** Part of PhD thesis submitted to Sri Venkateswara Veterinary University, Tirupati - 517502, Andhra Pradesh, India.

REFERENCES

Choct, M. 2011. *Feed Polysaccharides: Nutritional Roles and Effect of Enzymes presentation* given at the IV CLANA CBNA/AMENA, Sao Pedro, SP, Brazil in November 2010 Engormix.com.

Choct, M. 2006. *Enzymes for the feed industry: past, present and future* World's Poultry Science 81: 1842-1849.

Cowieson, A. J., Bedford, M. R. and Ravindran. V. 2010. *Interactions between xylanase and glucanase in maize-soy-based diets for broilers*. British Poultry Science 51 (2) 246-257.

Duncans, 1955. *Multiple range and multiple F- tests*. Biometrics 11: 1-42

Hong, D., Burrows, H. and Adeola, O. 2002. *Addition of enzymes to starter and grower diets for ducks*. Poultry Science 81:1842-1849

Malathi, V. and Devegowda, G. 2001. *In vitro evaluation of non starch polyaccharide digestibility of feed ingredients by enzymes*. Poultry Science 80(3): 302-305.

Nadeem, M. A., Anjum, M. I. Khan, A. G. and Azim, A. 2005. *Effect of dietary supplementation of non-starch polysaccharide degrading enzymes on growth performance of broiler chicks*. *Pakistan Veterinary Journal* 25 (4): 2005

Naqui, L. U. and Nadeem, A. 2004. *Bio availability of metaboliable energy through enzyme supplementation in broiler rations*. *Pakistan Veterinary Journal* 24(2):183-188

Narasimha, J., Nagalakshmi, D., Ramana Reddy, Y. and Viroji, Rao S. T 2013[a]. *Synergistic effect of non starch polysaccharide enzymes, synbiotics and phytase on performance, nutrient utilization and gut health in broilers fed with sub-optimal energy diets. Veterinary World,* 6(10): 754-7601

Narasimha, J. Nagalakshmi D, VirojiRao S.T, Venkateswerlu M. and Ramana Reddy Y 2013[b]. *Associative effect of non-starch polysaccharide enzymes and probiotics on performance, nutrient utilization and gut health of broilers fed sub-optimal energy diets*. *International Journal of Engineering and Science* 2 (10):28-31

Rama Rao, S. V., Prakash, B., Raju, M. V. L. N., Panda, A. K. and Murthy, O. K. 2014. *Effect of supplementing non-starch polysaccharide hydrolyzing enzymes in guar meal based diets on performance, carcass variables and bone mineralization in vanaraja chicken*. *Animal Feed Science Technology* 188: 85-91.

Ramesh, J. and Chandrasekaran, 2011[a]. *Effect of exogenous enzyme supplementation on performance of cockerels*. *Tamil Nadu Journal of Veterinary and Animal Sciences* 7(1): 29-34.

Santhi, D., Thyagarajan, D and Ramesh, J. 2014. *Effect of exogenous cellulase supplementation in feed on turkey poult performance. Indian Veterinary Journal*, 91(02) 9-11

Saunders, R. M. 1986. *Rice bran: composition and potential food uses*. *Food Reviews Science Journal* 62: 77-86.

Song Xizo Zhen, Zeng Fuhai, yang Xiujiang, Qu Ming Ren and Zhang Wei 2010. *Effects of different combinations of NSP enzyme preparations on small intestine mucosal structure and nutrient apparent availability of 1-21 days old broilers*. *Chinese Journal of Animal Nutrition* 22 (6): 1730-1737.

****