Effect of ß-D-Glucanase and ß-D-Mannanase with Two Various Levels of Metabolisable Energy on Performance of Broiler Chicks Fed Barley- Soybean Diets

Islamic Azad University
Varamin Pishva Branch
IRAN

Karimi, k.*, Sadeghi, A. A**., Forudi, F*

*:Animal Science Department, School of Agriculture, Islamic Azad University-Varamin Pishva Branch, Varamin,Tehran, Iran

**:Animal Science Department, School of Agriculture, Islamic Azad University-Tehran Science and Reasearch Branch, Tehran, Iran

EAAP2010- Greece

Session: 46 poster: 11

introduction

Researches on endogenous enzymes on birds showed that young birds at first days of their life haven't secret enough enzyme for hydrolysis of carbohydrates and plant proteins. Therefore, nutrient digestibility had been affected. Non starch polysaccharides (NSPs) are anti nutritive complexes which found in plant cell wall and can reduce the nutrient bioavailability. These include: some fibers such as lignin, B-glucans, Arabinoxylans (pentosans) and etc which found in poultry diets. Soybean meal and palm meal are reach from glucomannans and galactomanans. Soy bean meal has 1-2% b-manans. Barley, as a composition of poultry diets, have β (1-3) and β(1-4) glucans. Barley seeds have 4.2 % B-glucan. These Nsps increase the digesta viscosity and furthermore decrease the digestion and absorption of feeds. Addition of exogenous enzymes to the poultry diets is the best way to reduce these effects of NSPs. Enzymes can increase the nutrient bioavailability and digestibility and improve the performance and feed conversion ratio. Improvement of gain, metabolisable energy, water consumption, gastrointestinal size is the other advantages of enzyme supplementation. To determine the effects of NSP-enzymes on performance of broiler chicks, in this study, changes of feed intake(FI), gaine(G), Feed conversion ratio(FCR) and abdominal fat(AF) in response to endo-glucanase and mananase with ME reduction at barley-soybean meal based diets has been assayed.

Material and Methods

Birds, Housing and Cares: Two hundred and forty day-old male broiler chicks of commercial strain (Ross 308) were randomly assigned to 8 dietary treatments with 4 replicate pens of 10 chicks each one. Each pen was one square meter and covered with wood shaving the house temperature was initially maintained at 32○C and reduced 2.8○C every week to reach a constant temperature of 20-22○C at 28 day of age, a continuous lighting was used for the first 3 days and a 23:1h light: dark cycle was applied for the rest of the experimental period. Birds were allowed free access to the feed and fresh water throughout the experiment.

Experimental design and diets: The experiment was a completely randomized design with a 2*2*2 factorial arrangement of 2 levels of ME (H=equal of broilers need and L=100kcal.kg-1 lower than broilers need) and 2 level β-mannanase(M) supplementation (0 and 0.1%) and 2 levels of xylanase(X) supplementation (0 and 0.1%). Diets were formulated

Statistical Analysis: All data were analyzed by ANOVA using the GLM procedure of the SAS software. Means were compared for significant differences using Duncan's Multiple Range Test (P<0.05).

Table 1:Composition of the experimental diets

Ingredients (%)	Starter diets								Grower diets								Finisher diets							
	High ME				Low ME				High ME				Low ME				High ME				Low ME			
	Non enzyme	Mannanase	xylanase	Mannanase + xylanase	Non enzyme	Mannanase	xylanase	Mannanase + xylanase	Non enzyme	Mannanase	xylanase	Mannanase + xylanase	Non enzyme	Mannanase	xylanase	Mannanase + xylanase	Non enzyme	Mannanase	xylanase	Mannanase + xylanase	Non enzyme	Mannanase	xylanase	Mannanase + xylanase
Experimental Groups Label	LO	LM	LX	LMX	HO	HM	HX	HMX	LO	LM	LX	LMX	HO	HM	HX	HMX	LO	LM	LX	LMX	HO	HM	HX	HMX
Wheat	45	45	45	45	45	45	45	45	45	45	45	45	45	45	45	45	45	45	45	45	45	45	45	45
Soybean meal(44%CP)	39.05	39.05	39.05	39.05	39.05	39.05	39.05	39.05	36.96	36.96	36.96	36.96	36.96	36.96	36.96	36.96	30	30	30	30	30	30	30	30
Corn	4.11	4.11	4.11	4.11	4.25	4.25	4.25	4.25	4.29	4.29	4.29	4.29	4.29	4.29	4.29	4.29	12.78	12.78	12.78	12.78	12.78	12.78	12.78	12.78
Corn gluten(60 % CP)	4.25	4.25	4.25	4.25	2	2	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Vegetable oil	3.61	3.61	3.61	3.61	5.64	5.64	5.64	5.64	7.8	7.8	7.8	7.8	9	9	9	9	6.89	6.89	6.89	6.89	8.09	8.09	8.09	8.09
Limestone	2.19	2.19	2.19	2.19	2.15	2.15	2.15	2.15	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.27	1.27	1.27	1.27	1.27	1.27	1.27	1.27
Di-Ca-Phosphate	0.35	0.35	0.35	0.35	0.41	0.41	0.41	0.41	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Sodium Chloride	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32
Vitamin premix*	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Mineral premix**	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Hcl-Lysine	0.22	0.22	0.22	0.22	0.23	0.23	0.23	0.23	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14
DL- Methionine	0.18	0.18	0.18	0.18	0.2	0.2	0.2	0.2	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
B-mannanase(Hemicel®)	0	0	0.1	0.1	0	0	0.1	0.1	0	0	0.1	0.1	0	0	0.1	0.1	0	0	0.1	0.1	0	0	0.1	0.1
Xylanase(Rovabio)	0	0.1	0	0.1	0	0.1	0	0.1	0	0.1	0	0.1	0	0.1	0	0.1	0	0.1	0	0.1	0	0.1	0	0.1
Sand	0.2	0.1	0.1	0	0.23	0.13	0.13	0.03	1.4	1.3	1.3	1.2	0.2	0.1	0.1	0	1.4	1.3	1.3	1.2	0.2	0.1	0.1	0
Calculated nutrient																								
ME ($kcal.kg^{-1}$)	3010	3010	3010	3010	2910	2910	2910	2910	3175	3175	3175	3175	3075	3075	3075	3075	3225	3225	3225	3225	3125	3125	3125	3125
CP	24	24	24	24	24	24	24	24	22.2	22.2	22.2	22.2	22.2	22.2	22.2	22.2	19.9	19.9	19.9	19.9	19.9	19.9	19.9	19.9
Ca	1	1	1	1	1	1	1	1	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85
Av .Phosphorus	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42
Na	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16
Lys	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88
Met	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37
Met +Cys	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.69	0.69	0.69	0.69	0.69	0.69	0.69	0.69

* Supplied/kg: 3600000IU vit A, 800000IU D3, 3600000IU E, 800mg K3, 720mg B1, 2640mg B2, 4000mg B3, 12000mg B5, 1182 mg B6, 400mg B9, 40mg H2, 100000mg Colin Chloride and 150 mg Antioxidant.
** Supplied/kg: 40000mg Mn, 37000mg Zn, 20000mg Fe, 4000mg Cu, 400mg I2, 100000mg Colin chloride and 80 mg Se.

Results and Discussion

FI at 6th week of rising period reduced by increase the diet's ME level (p<0.01) Interaction between enzymes and ME levels was significant at week 4(P<0.01).ANOVA results showed that ME levels at 1-6 week's period affected gain significantly (p<0.05). Enzymes have the significant effects on gain at 6 and 1-6 weekly periods (p<0.05). Interaction between ME and enzymes showed that means of gain were different at 6 and 1-6 weekly periods (p<0.01). ANOVA showed the significant different by ME levels at week 4 (P<0.001) and week 5(P<0.05). In these weekly periods FCR improved by increase of diet ME (P<0.01). Enzymes have significant effects on FCR in all weekly periods. Interaction between ME and enzymes showed that means of FCR were different at 4, 5 and weekly periods (p<0.01).Increase of ME at 31 day-old chicks, reduced AF significantly (p<0.05). Enzymes have significant effect on AF at 41 day-old chickens (p<0.05). Mannanase supplementation at 41 day-old chickens increased AF with compare to control or 2 enzyme supplementation. Interaction between ME and enzymes showed that means of AF were different at 31 day-old chickens (p<0.05) In this study 100kcal/kg increasing in ME increases the HDL and triglycerides which is due to better fat digestibility and metabolism when broiler fed wheat soybean-based diet. Many of studies have shown that AME was positively correlated to Fat digestion (Friesen et al., 1992;). Smulikoweska and Mieczkoweska(2000) reported that 62% of the increase of the AMEn values was due to better fat digestibility when broiler Fed wheat-based diet supplemented with enzyme containing xylanase and β-glucanase activities. Scott *et all(*1998) reported that variation in AME among wheat or barley-based diets was significantly reduced with enzyme supplementation. Diets containing low AME cereal grains generally benefit more from enzyme supplementation than diets containing high AME cereal grain. Choct(2002) reported that enzyme supplementation significantly improved the nutritive value of a low AME wheat diet(<3,107 kcal/kg DM).

Dietary enzyme supplementation has been shown to increase AME. (Annison and choct, 1991).Endo-xylanase disrupts the water holding capacity of the NSP and reduces the viscosity of the digesta in small intestine (Bedfor, 2000; choct et al 1998). Endo-xylanase release entrapped nutrient for the digestion by endogenous enzymes of the birds(Chesson, 2000).The mechanism of action of the exogenous xylanases was long believed to be by the release of nutrients thorough the destruction of cell wall (Bedford, 2000). Even though this idea is partially true, there is considerable evidence that enzymes elicit benefits other than simply releasing nutrient from cellular constituents (Bedford, 2000). Jacson et al, (2002) suggest that the improvement in the animal performance is due to the effect of the enzyme on gut viscosity and consequently in gut digestion and microflora. There are ways to improve both the solubility and concentration of soluble β-glucan in the flour or bran (eg, by extrusion technology, 24) and these offer significant scope for future development in this area.

In terms of the public health significance of these findings, it is practical to achieve a significant increase in dietary fiber when more cereal-based foods are included. We found that barley foods were very acceptable alternatives.

Table 2: effect of treatments on Feed Intake (FI) of broilers in different age periods.

Effects	Age period(Week) 1-3	4	5	6	1-6
High ME	610.37±32.9	681.9±124.3	756.5±58	1047.8±55^{X}	3332.5±404.5
Low ME	623.03±26.3	620.3±73.2	735.6±26.5	968.3±89.7^{Y}	3245.2±205.7
Significance	NS	*	NS	*	NS
No Enzyme	600.3±50.7	642.6±136.3	745.3±57.5	1001.1±81.7	3348.7±288.7
Mannanase	623.7±32.8	731.5±129	774.3±56	1044±95.3	3576.3±140
Glucanase	632.9±16.8	617.3±82.4	739.7±24.7	1018±74.3	3169.5±455.1
Mannanase + Glucanase	608.2±10.8	633.2±62.8	730.5±46.6	953.2±75.7	3147.7±193.8
Significance	NS	NS	NS	NS	NS
Low ME and No Enzyme(LO)	566.7±49.1	785.8±50.4	773.4±69.8	1079.2±20.4	3586.5±67
Low ME and Mannanase(LM)	640.3±18.1	820.5±18.2	803.9±53.9	1058.4±64.6	3694.5±18.4
Low ME and Glucanase(LG)	626.4±10.3	574.2±82.9	741.7±33.7	1074.1±14.5	3025.1±575
Low ME and two enzymes(LMG)	603.5±12.6	628.1±97.5	706.9±41.9	998.8±60.4	3229.2±223.8
High ME and No Enzyme(HO)	633.9±28.3	547±40.7	717.2±31.9	949±54.6	3111±139.7
High ME and Mannanase(HM)	612.7±39.1	642.5±133.6	729.9±13	1030.7±134	3458.1±51.2
High ME and Glucanase(HG)	642.8±24.5	660.5±67.1	737.7±19.4	980.7±75.5	3386±103.9
High ME and two enzymes(HMG)	612.98±8.2	638.4±16.6	765.9±21	884.8±3.4	3025.6±18.1
Significance	NS	**	NS	NS	NS

Data include Mean ± standard error of mean (SEM).
NS: not significant, * difference at P<0.05, ** difference at P<0.01

Table 3: effect of treatments on gain (G) of broilers in different age periods.

Effects	Age periods (Week) 1-3	4	5	6	1-6
High ME	489.4±25.8	391.4±20.3	425.7±53.3	557.9±101.6	2020.3±187.8
Low ME	497.5±27.2	406.2±17.7	443±65.5	512.8±147.5	1894.2±291.9
Significance	NS	NS	NS	NS	*
No Enzyme	475±30.5^{B}	396.4±16.3	400.6±41.7^{B}	520±35.5^{AB}	1893.4±98.5^{AB}
Mannanase	493.4±16.8^{AB}	392.9±28	441.5±28.3^{AB}	402.3±119.8^{B}	1748.9±268.4^{B}
Glucanase	487.8±24.3^{AB}	406.5±14	414.3±63.4^{AB}	578.2±104^{A}	2084.7±134.1^{A}
Mannanase + Glucanase	514±22.7^{A}	401.6±24.7	491.5±68.2^{A}	635.7±103^{A}	2169.7±178.8^{A}
Significance	NS	NS	NS	**	***
Low ME and No Enzyme(LO)	478.8±42.2	385.5±16	435.5±16.05	508.1±17.5	1871.9±29.2
Low ME and Mannanase(LM)	487.1±18	375.7±31.2	447.9±5.16	504.3±7.7	1937.4±102.9
Low ME and Glucanase(LG)	487. 4±28.6	406.8±18.9	373.9±66.5	522.1±93.9	2002.2±158
Low ME and two enzymes(LMG)	504.4±14.5	400.3±15.3	471.5±14.1	714.7±28.3	2310.9±28.6
High ME and No Enzyme(HO)	469.3±7.8	407.3±7.3	365.8±10.4	532.0±53.9	1914.9±162.5
High ME and Mannanase(HM)	499.6±16.2	410.1±14.3	437.13±38.9	300.1±36.2	1466.1±23.1
High ME and Glucanase(HG)	488.2±25.6	406.07±15.2	454.6±27.2	662.2±46.1	2167.2±41.9
High ME and two enzymes(HMG)	523.6±28.3	402. ±33.1	511.5±110.2	556.6±78.4	2028.5±124
Significance	NS	NS	NS	**	**

Data include Mean ± standard error of mean (SEM).
NS: not significant, * difference at P<0.05, ** difference at P<0.01

Table 4: effect of treatments on feed conversion ratio (FCR) of broilers in different age periods.

Effects	Age periods (Week) 1-3	4	5	6	1-6
High ME	1.28±0.09	1.83±0.32^{X}	1.84±0.24	1.95±0.37	1.74±0.24
Low ME	1.24±0.11	1.46±0.16^{Y}	1.67±0.21	1.88±0.39	1.7±0.13
Significance	NS	***	*	NS	NS
No Enzyme	1.33±±0.14^{A}	1.6±0.37	1.91±0.06^{A}	2.06±0.31^{AB}	1.76±0.19^{AB}
Mannanase	1.3±0.1^{AB}	1.75±0.15	1.59±0.08^{B}	2.25±0.37^{A}	1.89±0.11^{A}
Glucanase	1.25±0.06^{AB}	1.48±0.15	1.86±0.3^{AB}	1.71±0.23^{B}	1.63±0.08^{B}
Mannanase + Glucanase	1.18±0.04^{B}	1.66±0.12	1.6±0.19^{AB}	1.64±0.25^{B}	1.62±0.62^{B}
Significance	*	*	**	*	NS
Low ME and No Enzyme(LO)	1.27±0.14	2±0.04	1.87±0.04	2.32±0.16	1.83±0.25
Low ME and Mannanase(LM)	1.37±0.06	2.19±0.13	1.58±0.11	2.16±0.06	1.97±0.04
Low ME and Glucanase(LG)	1.29±0.05	1.39±0.08	2.20±0.11	1.88±0.16	1.68±0.08
Low ME and two enzymes(LMG)	1.20±0.03	1.77±0.02	1.69±0.07	1.44±0.13	1.44±0.10
High ME and No Enzyme(HO)	1.43±0.07	1.34±0.11	1.97±0.06	1.80±0.04	1.68±0.10
High ME and Mannanase(HM)	1.22±0.07	1.31±0.02	1.60±0.10	2.34±0.62	1.82±0.12
High ME and Glucanase(HG)	1.19±0.03	1.59±0.15	1.63±0.13	1.55±0.16	1.60±010
High ME and two enzymes(HMG)	1.17±0.06	1.59±0.11	1.53±0.29	1.85±0.12	1.74±0.20
Significance	NS	**	**	*	NS

Data include Mean ± standard error of mean (SEM).
NS: not significant, * difference at P<0.05, ** difference at P<0.01

Table5: effect of treatments on relative weight of abdominal fat (AF) of broilers in different age periods.

Effects	Age (day) 31	41
High ME	0.008463±0.0034668^{X}	0.010426±0.0037342
Low ME	0.05368±0.0023573^{Y}	0.011836±0.0033718
Significance	*	NS
No Enzyme	0.008565±0.0045755	0.008458±0.0020496^{B}
Mannanase	0.006505±0.0029586	0.011946±0.0011938^{AB}
Glucanase	0.006317±0.0028231	0.014895±0.0015099^{A}
Mannanase + Glucanase	0.006104±0.002606	0.0010069±0.0048138^{B}
Significance	NS	*
Low ME and No Enzyme(LO)	0.012525±0.002052	0.008272±0.001658
Low ME and Mannanase(LM)	0.008089±0.001873	0.011029±0.000895
Low ME and Glucanase(LG)	0.004518±0.002325	0.015694±0.0003035
Low ME and two enzymes(LMG)	0.007404±0.002731	0.006708±0.0008962
High ME and No Enzyme(HO)	0.004605±0.001036	0.008582±0.0026398
High ME and Mannanase(HM)	0.004133±0.003035	0.012864±0.0003283
High ME and Glucanase(HG)	0.007517±0.002799	0.014096±0.0020477
High ME and two enzymes(HMG)	0.004805±0.002111	0.013430±0.0048511
Significance	*	NS

Data include Mean ± standard error of mean (SEM).
NS: not significant, * difference at P<0.05, ** difference at P<0.01

References

Annison, G., and Choct, M., 1991. Antinutritional activities of cereal non-starch Polysaccharides in broiler diets and strategies minimizing their effects. World's Poult. Sci. J. **47:232–241.**

Bedford, M. 2000. Removal of antibiotic growth promoters from poultry diets: implications and strategies to minimise subsequent problems. World's Poult. Sci. J. 56:347–365.

Chesson, A. 2000. Feed enzymes. Animal Feed Science 7 Technology. 45: 65-79.

Choct, M., and G. Annison. 1992. The inhibition of nutrient digestion by wheat pentosans. Br. J. Nutr. 67:123–132

Choct, M., R. J. Hughes, R. P. Trimble, K. Angkanaporn, and G. Annison. 1995. Non-starch polysaccharides-degrading enzymes increase the performance of broiler chickens fed wheat of low apparent metabolizable energy. J. Nutr. 125:485–492

Choct, M. 2002. Non-starch Polysaccharides: Effect on nutritive value. Pages **221–235** in Poultry Feedstuffs: Supply, Composition and Nutritive Value. J. McNab and N. Boorman, ed.

Friesen, O. D., Guenter, W., Marquardt, R. R., and Rotter, B. A., 1992. The effect of enzyme supplementation on the apparent energy and nutrient digestibilities of wheat, barley, oats, and rye for the young broiler chick. Poult. Sci. **71:1710–1721.**

Jackson, M.E., D. M. Anderson, R. L. James, H. Y. Hsiao, F. L. Jin, & G. F. Mathis. 2003. Effects of β-Mannanase (Hemicell®) compared to antibiotics on broiler chicken performance and flock weight uniformity to 42 days. Poultry Science Vol. 82 Suppl. 1.

Scott, T. A., F. G. Silversides, H. L. Classen, M. L. Swift & M. R. Bedford. 1998. Effect of cultivar and environment on the feeding value of western Canadian wheat and barley samples with and without enzyme supplementation. Canadian Journal of Animal Science. 78: 649-656