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The Effects of Different Growth Promoters on Performance and Carcass Characteristics of Broiler Chickens

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Abstract: This research was conducted to study the efficacy of different growth promotors on the productive performance and carcass yield of broiler chickens. About 840 sexed male ROSS 308 hybrid chickens were used according to completely randomized design in five treatments and one control. Thus, there were six group of chickens, 1) control diet (with out any promotors), 2) control diet + antibiotic, 3) control diet + probiotic, 4) control diet+prebiotic, 5) control diet+phytobiotic and 6) control diet+symbiotic. The productive indicators evaluated were: feed intake, weight gain, Feed Conversion Ratio (FCR). Also, it was determined the carcass yield and the main portions (breast, thigh and abdominal fat). In all over of current study, there wasn't any significant difference between treatments in body weight gain but all of them had beneficial effect compare to control. Lowest feed conversion ratio was belong to probiotic group and cause more efficient feed intake. Treatments vs. control increased carcass yield significantly but the difference between treatments was not significant. Breast and thigh was not affected by treatments and there wasn't any significant difference between treatments and control group. Lowest abdominal fat were seen in antibiotic group. According to the results probiotic and symbiotic appeared to be superior compare to other growth promotors. However, more studies are needed to confirm these findings and other aspects of growth promotors in the broiler diets.

Key words: Growth promotors, antibiotic, probiotic, prebiotic, phytobiotic, symbiotic

INTRODUCTION

Growth promoter feed additives have been included in poultry diets to promote growth, protect health and maximize the genetic potential of modern broiler and layer hybrids for the several past decades. For example, antibiotics are one of them and have been used at sub therapeutic doses in animal feeds, including poultry diets, for over five decades to prevent disease, promote growth and feed conversion efficiency (Eyssen and De Somer, 1963; Harms *et al*., 1986; Rosen, 1996; Engberg *et al*., 2000). Antibiotics induce their effect by stabilizing the intestinal microbial flora thereby preventing proliferation of specific intestinal pathogens (Truscott and Al-Sheikhly, 1977; Visek, 1978; Shane, 2005). Today, the non-prescription use of antibiotics in poultry feeds has been eliminated or severely limited in many countries because of concerns related to development of antibiotic-resistant human pathogenic bacteria and legislative action to limit their use in probable, in many others.

This limitation prompted the search and development of alternatives like probiotics, yeast cultures, organic acids, prebiotics, enzymes, botanicals including extracts and essential oils of some herbs and spices (Gill, 1999; Langhout, 2000; Hertrampf, 2001; Hooge, 2006). Probiotics have been defined as viable microorganisms (bacteria or yeasts) that exhibit a beneficial effect on the health of the host when they are ingested. Several studies have shown that the addition of probiotics to the diets of broilers leads to improved performance (Jin *et al*., 1997, 1998). Gibson and Roberfroid (1995) defined a prebiotic as a non-digestible food ingredient which beneficially affects the host by selectively stimulating the growth of and/or activating the metabolism of one or a limited number of health-promoting bacteria in the intestinal tract, thus improving the host's microbial balance. It has been shown that prebiotics stimulate the growth of endogenous microbial population groups such as bifidobacteria and lactobacilli is specifically stimulated and these bacteria species are perceived as beneficial to animal health. Also, dietary supplementation of fructo-oligosaccharide (0.3% dose) or oligochitosan (0.1% dose) as prebiotic,

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showed growth-promoting effects similar to antibiotic treatments based on flavomycin (Huang *et al.*, 2005) or aureomycin (Li *et al.*, 2008).

Natural medicinal products originating from herbs and spices have also been used as feed additives for farm animals in ancient cultures for centuries. To differentiate from the plant products used for veterinary purposes (prophylaxis and therapy of diagnosed health problems), phytobiotics were redefined by Windisch and Kroismayr (2006) as plant-derived products added to the feed in order to improve performance of agricultural livestock.

In simplest definition, symbiotic is a combination of probiotics and prebiotics (Collins and Gibson, 1999; Schrezenmeir and De Vrese, 2001). This product could improve the survival of the probiotic organism because its specific substrate is available for fermentation. This could result in advantages to the host through the availability of the live micro-organism and the prebiotic. The objective of the present study was to determine the effects of different growth promotors as feed additives on performance of broiler chicken.

MATERIALS AND METHODS

This experiment was conducted in summer of 2009. The growth experiment included 1 day old sexed male ross 308 hybrid chickens. About 1 day old chickens were placed in cages in the experimental enclosure of the Zarball farm in Amol, Iran. One cage sized 100×220×80 cm (W×L×H) accommodated 24 chickens. A total of 840 males were placed in 24 cages. The chickens were given the starter mixture from day 1-10, followed by the grower from day 11-28 and the finisher in a loose form from day 29-42. The composition of the diets and the content of nutrients are specified in Table 1.

Avilamycin was added to the basal diet at the dosage of 100 g ton^{-1}. The probiotic feed additive-GalliPro-comprising a probiotic B. subtilis strain (DSMZ 17299) was added to the basal diet at the dosage of 200 g ton^{-1}.The prebiotics-Immonowall-comprising β-glucan and Mannano Oligosacharid (MOS) was added 2 kg ton^{-1} in 1st week and after that was added 1 kg ton^{-1}. The phytobiotic-Digestrum as a plant product was added to the basal diet at the dosage of 150 g ton^{-1}. Immonowall and Gallipro were added together to the basal diet as a symbiotic. Chickens received the diets and water *ad libitum*. Air temperature and humidity were adjusted according to the Ross technological procedure for broiler fattening. Illumination was constant. The chickens were weighed on Days 1, 10, 28 and 42, at an accuracy of ±1 g. The consumption of diets was monitored continually for each cage at the following intervals of consumption monitoring: days 1-10, days 11-28 and days 29-42. At the end of the experiment, 42 day old chickens were subjected

Table 1: The ingredient and chemical composition of diets administered to broiler chickens

Ingredients	1-10 days	11-28 days	29-42 days
Corn, grain	49.20	62.78	67.08
Soybean meal 44%	39.10	27.56	23.99
DCP	2.00	1.90	1.65
Poultry BP meal	2.00	5.00	4.00
Sunflower oil	0.31	0.78	1.11
DL-Methionine	0.04	0.26	0.21
L-Lysine HCl	0.03	0.21	0.18
L-Threonine	0.01	0.05	0.04
Vitamin and mineral premix	0.50	0.50	0.50
Salt	0.01	0.09	0.12
Sodium bicarbonate	0.02	0.27	0.24
Formaicin Gold	0.01	0.10	0.10
Oyster shells	0.40	0.45	0.72
Salinomycin	-	0.05	0.05
Zeolit	0.20	-	-
Chemical composition of diets (%)			
Metab. Energy (kcal kg^{-1})	2890.00	3000.00	3050.00
Protein	21.30	19.20	17.51
Calcium	1.01	0.86	0.81
Avail. Phos.	0.48	0.40	0.35
Sodium	0.16	0.18	0.18
Arginine	1.41	1.23	1.10
Lysine	1.38	1.15	1.01
Methionine	0.70	0.55	0.48
Met+Cys	1.03	0.88	0.78
Threonine	0.91	0.78	0.70

to control slaughter to determine the slaughter yield (Carcass, breast and thigh) and the content of abdominal fat in the final product. Also, at the end of training period, feed intake, weight gain and feed conversion ratio were calculated. All data were subjected to ANOVA using the General Linear Models procedure of SAS software (SAS Institute, 1996). The mean differences among different treatments were separated by Duncan's multiple range tests. A level of ($p<0.05$) was used as the criterion for statistical significance.

RESULTS AND DISCUSSION

Performance traits of broiler chickens including body weight, feed intake and feed conversion ratio are shown in Table 2. Symbiotic group (Immonowall + Gallipro) showed higher feed intake in each period and all over of the trial. About 11-28 days, Probiotic (Gallipro) had lower feed intake and there wasn't any significant difference between other treatments with conrol group ($p>0.05$). In finisher period, probiotic group showed lower feed consumption, whereas other groups hadn't significant difference ($p<0.05$).

Also, from 1-42 days, probiotic group showed lowest feed intake between other treatments. The results of current trial showed that the substitution of the control by the alternative diets resulted in significantly higher body weight gain at 1-10 days of age. The Antibiotic (Avilamycin), Probiotic (Gallipro) and Symbiotic (Immonowall + Gallipro) had best performance on weight

Table 2: Feed intake, weight gain, feed conversion ratio of treated broilers

Parameters	Control	Avilamycin	Gallipro	Immunowall	Digestrom	Gallipro+Imm unowall	SEM
Feed intake (g)							
1-10 days	277.37^{c}	283.68^{b}	277.008^{c}	280.66^{bc}	277.20^{c}	287.19^{a}	0.950
11-28 days	1332.66^{b}	1330.91^{b}	1292.250^{c}	1322.35^{b}	1335.16^{b}	1375.90^{a}	6.250
29-42 days	2177.32^{ab}	2199.58^{a}	2149.970^{b}	2231.74^{a}	2216.74^{a}	2197.04^{a}	14.980
1-42 days	3787.36^{b}	3814.17^{ab}	3719.470^{c}	3834.75^{a}	3829.10^{a}	3860.13^{a}	16.490
Weight gain (g)							
1-10 days	177.67^{c}	201.47^{a}	199.480^{a}	194.64^{ab}	187.35^{b}	197.81^{a}	1.240
11-28 days	629.94^{b}	592.77^{bc}	637.010^{ab}	568.82^{c}	672.90^{a}	679.12^{a}	9.660
29-42 days	1091.64^{b}	1147.07^{a}	1145.740^{a}	1154.79^{a}	1096.74^{b}	1070.40^{a}	13.510
1-42 days	1899.25^{b}	1941.31^{a}	1982.230^{a}	1918.25^{a}	1956.99^{ab}	2047.33^{a}	20.180
Feed conversion ratio							
1-10 days	1.56^{a}	1.40^{ab}	1.380^{c}	1.44^{b}	1.48^{ab}	1.45^{b}	0.015
11-28 days	2.11^{b}	2.24^{a}	2.020^{c}	2.32^{a}	1.98^{c}	2.02^{c}	0.029
29-42 days	1.99^{a}	1.91^{bc}	1.870^{c}	1.93^{b}	2.02^{a}	1.87^{c}	0.027
1-42 days	1.99^{a}	1.96^{b}	1.870^{c}	1.99^{a}	1.95^{b}	1.88^{c}	0.018

Means within rows followed by different letters are significantly different (p<0.05)

Table 3: The effect of treatment on carcass weight, carcass yield and abdominal fat of male broilers

Parameters (%)	Control	Avilamycin	Gallipro	Immunowall	Digestrom	Gallipro+Imm unowall	SEM
Carcass yield	63.27^{b}	64.08^{ab}	67.92^{a}	67.31^{a}	68.40^{a}	67.93^{a}	1.41
Breast	29.58^{a}	30.37^{a}	29.67^{a}	29.88^{a}	30.73^{a}	30.04^{a}	0.74
Thigh	28.24^{a}	29.62^{a}	29.60^{a}	29.26^{a}	28.06^{a}	29.76^{a}	0.56
Abdominal fat	2.11^{a}	1.68^{c}	1.74^{bc}	1.87^{b}	1.93^{ab}	1.71^{bc}	0.06

Means within rows followed by different letters are significantly different (p<0.05)

gain of chicks at 1-10 days. In the grower period, the differences of weight gain for prebiotic (Immunowall) group was significantly lower compare to other groups ($p<0.05$). Control and Digestrom groups had significant difference with the other groups and they showed lower weight gain in finisher period. From 1-42 days, control group showed lower weight gain but there weren't any significant difference between treatments.

In the starter period of current study, probiotic (Gallipro) group showed lowest (1.38) and control group had highest feed conversion ratio. Thus, probiotic group had better performance during this period. Antibiotic (Avilamycin) and prebiotic (Immonowall) groups, showed higher feed conversion ratio in grower period but there weren't any significant differences between probiotic, phytobiotic and symbiotic groups in this period ($p>0.05$). Control and phytobiotic groups showed higher and probiotic and symbiotic groups had lower feed conversion ratio in finisher period. From 1-42 days, there weren't any significant difference between control and prebiotic groups and they had higher feed conversion ratio compare to other groups. On the other hand, probiotic and symbiotic groups had lower feed conversion ratio (1.87 and 1.88, respectively) and better performance between other groups in whole period of present study. The main results of carcass traits are set out in Table 3. Carcass yield was influenced ($p<0.05$) by treatment and almost all groups showed better carcass yield compare to control group. However, there weren't any significant difference between Control and Avilamycine groups in carcass yield ($p>0.05$). Breast and thigh weight as a percentage of carcasses weren't affected by treatments. Thus, there weren't any significant difference between control and treated groups ($p>0.05$). On the other hand, treatments had significant effect on abdominal fat percentage. Antibiotic, probiotic and symbiotic groups showed lower abdominal fat percentage. Whereas, highest values of abdominal fat were shown in control and Phytobiotic groups.

Broiler production is an important part of commercial poultry enterprise which can provide maximum return with a minimum expense. Broiler industries are providing a large part of increasing demand for animal protein, cash income and creating employment opportunities. Broiler industry needs fast growing broiler chicks which are capable of converting diet into meat with a great efficient. Growth promoters as feed additive are using in poultry industry for faster growth and economical meat production which also reduce time required for attaining the market weight (Bunyan *et al*., 1977). Growth promoters have the positive response in respects to broiler growth (Milligan *et al*., 1955; Denli *et al*., 2003). Addition of antibiotics as feed additive in the diet of broilers improved weight gain, diet intake and reduced feed conversion ratio (Yang *et al*., 2009). Bedford (2000) pointed out that the growth-promoting effects of antibiotics in animal diets are clearly related to the gut microflora because they exert no benefits on the performance of Germ-Free (GF) animals.

Gut microflora has significant effects on host nutrition, health and growth performance (Barrow, 1992) by interacting with nutrient utilization and the development of gut system of the host. When pathogens attach to the mucosa, gut integrity and function are severely affected (Droleskey *et al*., 1994) and immune system threatened (Neish, 2002). Chicks grown in a pathogen-free environment grow 15% faster than those grown under conventional conditions where they are exposed to bacteria and viruses (Klasing, 1987). As were shown in Table 2 in current study use of Avillamycin vs control group significantly affected weight gain except growth period.

However, antibiotics have been banned to prevent the development of antibiotics-resistant human pathogenic bacteria and to remove antibiotics residues in poultry products. Results of current study showed that probiotic group had higher weight gain compare to control group. Addition of probiotics to feed is one of the alternatives to be used as a replacement for antibiotics. There is sufficient evidence to show that probiotics are effective in enhancing the immune system, increasing body weight gain, reducing diarrhea and improving feed conversion efficiency (Reid and Friendship, 2002; Patterson and Burkholder, 2003). A variety of microbial species have been used as probiotics, including species of *Bacillus*, *Bifidobacterium*, *Enterococcus*, *Escherichia*, *Lactobacillus*, *Lactococcus*, *Streptococcus*, a variety of yeast species and undefined mixed cultures.

Lactobacillus and *Bifidobacterium* species have been used most extensively in humans whereas species of *Bacillus*, *Enterococcus* and *Saccharomyces* yeast have been the most common organisms used in livestock (Simon *et al*., 2001). Two basic mechanisms by which probiotics act to maintain a beneficial microbial population include competitive exclusion and immune modulation. Competitive exclusion involves competition for substrates, production of antimicrobial metabolites that inhibit pathogens and competition for attachment sites.

Probiotic supplementation, especially with *lactobacillus* species has also shown beneficial effects on resistance to the other infectious agents such as Clostridium population (Decroos *et al*., 2004) and Campylobacter (Stern *et al*., 2001).

Regarding the gut microbiota of normal birds, the results of probiotics supplementation are variable because of the difference in origin, strain as well as species of probiotics. Reduced caecal coliform populations were noticed in chickens given a diet supplemented with lactobacilli strains, isolated from chicken intestine but the populations of other kinds of bacteria were not affected (Watkins, 1984; Jin *et al*., 1998). In contrast, Murry *et al*. (2006) reported that birds supplemented with botanical probiotic containing lactobacilli had higher lactobacilli but lower *C. perfringens* compared to the control birds.

When multi-strain and/or multi-species probiotics were applied, no significant change (s) in bacterial populations was noticed (Priyankarage *et al*., 2003; Mountzourism *et al*., 2007). The inconsistency may become more complex because of rearing environment. For example, under heat stress condition, lactobacilli probiotic supplementation improved Body Weight Gain (BWG) of female birds by 12% but increased FCR and mortality rate by 4 and 29%, respectively (Zulkifli *et al*., 2000). Fritts *et al*. (2000) used the probiotic product containing *Bacillus subtilis* C-3102 (Calsporin). When this product was administered to chickens in the diet for a period of 42 days, their live weight increased and feed conversion improved. However, growth-promoting effects of certain probiotics were reported to be comparable to antibiotic treatments (virginiamycin, Cavazzoni *et al*., 1998; oxytetracycline, Zulkifli *et al*., 2000; avilamycin, Mountzourism *et al*., 2007). Rostagno reported that, Use of GalliPro® in diet improved body weight at slaughter and feed conversion ratio. Thus, the growth-promoting effects of probiotics are dependent on the specific probiotics, the application level of probiotics, the age of birds as well as the delivery method (i.e., via water and/or feed). Prebiotics have the advantage, compared with probiotics, that bacteria are stimulated which are normally present in the GIT of that individual animal and therefore already adapted to that environment (Snel *et al*., 2002). The dominant prebiotics are fructo-ligosaccharide products (FOS, oligofructose, inulin) (Patterson and Burkholder, 2003); gluco-oligosaccharides, stachyose, malto-oligosaccharides and oligochitosan have also been investigated in broiler chickens (Zhan *et al*., 2003; Gao and Shan, 2004; Jiang *et al*., 2006; Huang *et al*., 2007).

Prebiotics are differentiated from colonic foods in that the latter serve as general fuels for the endogenous colonic microflora, thus providing the host with energy, metabolic substrates and essential micronutrients. Much of the previous research focus on prebiotics has concentrated on Oligosaccharides (OS), principally Fructo-Oligosaccharides (FOS) and galacto-oligosaccharides. These compounds are indigestible by human digestive enzymes and have welldocumented effects on the large-bowel microflora. Although they are classified as colonic foods, they also meet the criteria for prebiotics (Gibson and Roberfroid, 1995). Reduced susceptibility to Salmonella colonization was noticed in birds on fructo-oligosaccharide treatments compared to controls (Bailey *et al*., 1991; Fukata *et al*., 1999).

The addition of isomalto-oligosaccharides and stachyose did not affect crop and/or caecal bacterial populations such as lactobacilli, *E. coli* and total aerobes (Zhan *et al*., 2003; Jiang *et al*., 2006). It was shown that prebiotics can bring about bifidogenic effects and a shift in microbial metabolism from proteolytic to the more favorable saccharolytic in mice (Gibson and Roberfroid, 1995). The optimal dose for prebiotics to exert growth-promoting effects is not easy to define; however feeding a higher level (0.8%) of inulin and short-chain fructo-oligosaccharide depressed growth performance, digestibility of amino acids as well as metabolisable energy of birds (Biggs *et al.*, 2007). The results of present study showed that Immunowall treated chickens had higher weight gain and feed conversion ratio. But it seems that the dose of prebiotic was not enough to exert their stark effect.

Around the world, phytobiotics have been investigated as natural sources of biologically important chemicals since efforts are being made to ban all types of antibiotics in many countries. Compared with synthetic antibiotics or inorganic chemicals, these plant-derived products have proven to be natural, less toxic, residue free and are thought to be ideal feed additives in food animal production (Wang *et al.*, 1998). Antimicrobial activity and immune enhancement probably are the two major mechanisms by which phytobiotics exert positive effects on the growth performance and health of animals. Compounds in phytobiotics are well known to have antimicrobial ability (Cowan, 1999). Polysaccharide components are considered to be the most important immunoactive components (Xue and Meng, 1996). In diseased chickens (either infected with avian *Mycoplasma gallisepticum* or *Eimeria tenella*), Guo and his colleagues (Guo *et al.*, 2004) demonstrated that plants and their extracts could improve the growth performance, reduce the populations of coliforms and/or *C. perfringens* and enhance both cellular and humoral immune responses of chickens. Increased feed intake and digestive secretions are also observed in animals offered phytobiotic-supplemented feed (Windisch and Kroismayr, 2006). Growth enhancement through the use of phytobiotics is probably the result of the synergistic effects among complex active molecules existing in phytobiotics (Gauthier, 2005). However, the exact growth promoting mechanisms of phytobiotics in broiler chickens are poorly understood.

Four factors may affect the effectiveness of phytobiotic additives: Plant parts and their physical properties, source, harvest time and compatibility with the other ingredient (s) in the feed (Yang *et al.*, 2009) which may also explain why 50% difference in BWG and 63% difference in FCR could happen when different kinds of phytobiotics are used in chicken diet. Although, results of current study showed that chickens offered with phytobiotic had higher performance (weight gain and feed conversion ratio) than control group but their performance was not higher than probiotic treated broiler chickens (Table 2). Resilts of present study showed that, Synbiotic (Gallipro+Immunowall) in the diet significantly improved the body weight gain and feed conversion ratio. Simillary, Panda *et al.* (2000) observed that broilers fed a diet containing Lactobacillus sporogenes (as a probiotic) had greater BWG and better FCR during the experimental period (1-42 day). Also, it has been reported that the addition of prebiotics such as Mannano-Oligosaccharide (MOS) and Fructo-Oligosaccharide (FOS) have made an improvement on growth performance in poultry (Iji *et al.*, 2001; Yang *et al.*, 2009; Yusrizal and Chen, 2003). Potentially, probiotic and prebiotic combinations (referred to as synbiotics) may have benefits greater than that of the probiotic alone, because the prebiotic may enhance the growth, colonization or activity of the probiotic species. In current study the occurrence of a significantly higher growth performance in broilers fed synbiotic is evidence on this claim.

CONCLUSION

In conclusion, the present study reveals that addition of different growth promoters may be beneficial and worthy for broiler production. It is obvious that the supplementation of broiler chicken diet with probiotic and symbiotic had positive effect on performance and carcass yield. But, the level of supplementation should be carefully considered due to a variety of factors. However, more studies are needed to confirm these findings and other aspects of growth promotors in the broiler diets.

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