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Effect of dietary supplementation of probiotic (Addon Poultry Max) on growth performance and carcass characteristics in commercial broiler chicken

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Abstract
Probiotic (Addon Poultry Max) effects on growth performance (body weight gain, feed consumption, feed conversion ratio) and carcass characteristics (ready to cook yield, weights of liver, heart, gizzard, abdominal fat, intestine, breast yield, spleen, thymus, and bursa) were studied. Two hundred and forty, day old chicks were allocated randomly into four treatments with three replicates in each treatment (20 birds in each replicate) and were fed standard feed. The trial was conducted for 42 days which comprised of four dietary treatments wherein, T1 served as basal diet. Basal diet+ 250g/ton (AGP), basal diet + probiotic (Addon Poultry Max @250g/ton) and basal diet + Probiotic (Addon Poultry Max 250g/ton) and Enrofloxacin (10ml/100kg BW) levels were designated as T2, T3 and T4 respectively. There was a significant increase in the body weight gain, feed consumption and feed conversion ration in T3 group followed by T4 group when compared to the control (T1) group. All dietary supplements did not have significant (P>0.05) effect on various carcasses parameters except breast yield. The breast yield was significantly (P<0.05) higher in probiotic, at 42 days, while the rest of the treatment groups did not differ from control. Mortality was more in control group and least in combined antibiotic and probiotic supplemented group followed by probiotic added group. Hence, it can be concluded that, supplementation of probiotics (Addon Poultry Max) as alternative to antibiotic can be used for improving performance of broiler chicken.

Keywords: Broilers, probiotic, antibiotic, performance, carcass

Introduction
Broiler production has become an important economic activity all over the world in the last few decades. India, large with an annual production (BAHS, 2015) of around 73.21 billion eggs and 3.725 million metric tons of poultry meat, ranks 3rd in egg production and 7th in broiler meat production, respectively, in the world. Antibiotics have been used as growth promoters for more than 5 decades in the feed industry to get advantage of increasing protection against some diseases, toxins, increasing nutrients absorption in intestine. However, because of the possible development of resistance by pathogenic bacteria against antibiotics, their efficacy was reduced besides public health impact due to their residues in eggs and meat. The probiotic is reported to regulate gut integrity, enhance useful microbial environment, reduce digestive disorders, improve nutrient absorption and utilization, increases production and check the mortality. The probiotics may provide an alternative to the administration of sub therapeutic levels of antibiotics in preventing the colonization of the gastro intestinal tract by unfavorable microorganisms. Probiotics act in tandem with adhesion receptors on the gut epithelium, with nutrients, produce antibacterial substances, stimulate immunity and reduce mortality. The supplementation of probiotic to the diet significantly improved the live weight and feed conversion ratio of the chicken (Roozbeh Shabani *et al*., 2012b).
Antibiotics and probiotics are used separately as feed additives in poultry rations for the positive growth response but the information on combined feeding of those feed additives is limited further more information is available on alternative feeding of antibiotic and probiotic and vice versa. Similarly more information is also available on the immuno- modulating effect on probiotic. Hence, the present study was designed to explore the influence of antibiotic & probiotic and their combination feeding on broiler performance and carcass characteristics of commercial broilers.

Methodology
Two Hundred and Forty birds were housed in each deep litter with an average floor space of

82 square inches or 205 sq. cm per bird. Feed and water were offered *ad lib*. and the birds were raised under identical management conditions. The routine vaccination schedule was followed. A growth trial was conducted in randomized block design, comprising of four dietary treatments, where in first treatment (T1) served as basal diet. Basal diet + 250g/ton (AGP), basal diet+ 250g/ton (Probiotic), (basal diet+ 250g/ton of Probiotic and Enrofloxacin 1oml/100kg BW) levels were designated as T1, T2, T3, and T4, respectively. Three replicates were allocated to each of the treatments, employing Twenty birds /replicate (Table 1). Probiotic (Addon Poultry Max) is proprietary commercial probiotic product, prepared by Virbac Indian Private limited company, Mumbai. It is a mixture of *Bacillus coagulans* $1.5X10^9$ *Bacillus licheniformis* $0.8X10^9$, *Bacillus subtilis* $1.5X10^9$ *Lactobacillus acidophilus* 0.2X10.

Study of performance parameters

The data on body weight was recorded on individual birds, while the cumulative feed consumption of each replicate was recorded at weekly intervals. On the day of mortality, the feed was weighed back in that particular group for the sake of accuracy in data collection on feed consumption. The feed conversion ratio was calculated using feed consumption and body weight gain data.

Table 1: Different treatment groups

Treatments	Probiotic in diet
1	Basal diet without probiotic & Antibiotic
2	Basal diet + antibiotic 250g/ton lincomycin
3	Basal diet+ probiotic 250g/ton
4	Basal diet+ probiotic 250g/ton Antibiotic 10ml/100kg bw (Enrofloxacin)

Study of carcass parameters

Carcass parameters were studied at the end of the experiment (42 days) on five birds from each replicate. The parameters studied were dressed yield, eviscerated yield, individual organ weights like liver, heart and gizzard, intestinal weight, using the data of liver, heart and gizzard weight, giblet yield was calculated, while ready to cook yield was arrived at by adding eviscerated and giblet yields.

Table 2: Experimental diets fed to broiler chickens

Ingredient	Prestarter (0-14d)	Starter (15-28d)	Finisher (29-42d)
Maize	53.7	56	59.1
Oil	1.6	4	4
Soyabean meal	40	35	32.2
Shell grit	1.65	1.83	1.75
Dicalcium phosphate	1.85	1.95	1.89
Salt	0.4	0.4	0.4
DL-Methionine	0.21	0.19	0.15
L-Lysine HCl	0.11	0.14	0.15
Trace Mineral Mixture	0.1	0.1	0.1
Vitamin AB2D3K	0.02	0.02	0.02
Vitamin B-Complex	0.025	0.025	0.025
Coccidiostat	0.05	0.05	0.05
Antibiotic	0.05	0.05	0.05
Choline chloride (50%)	0.1	0.1	0.1
Toxin binder	0.1	0.1	0.1
Tylosine	0.05	0.05	0.05
Total	**100**	**100**	**100**
Nutrient composition			
ME(kcal/kg)	2911	3070	3106
Crude protein (%)	22.56	21.74	19.51
Lysine (%)	1.3	1.21	1.02
Methionine (%)	0.55	0.50	0.45
Calcium (%)	1.0	1.06	1.01
Available phosphorous (%)	0.45	0.46	0.45

Results and Discussion

The performance of the commercial broilers which were fed with different diets having probiotics, commercial antibiotics and a combination of probiotics and antibiotics are compared to control group in terms of body weight, feed consumption, feed efficiency, mortality, carcass parameters.

I. Performance parameters

a. Live body weight and Body weight gain

The data on Live body weight and cumulative body weight gain as influenced by levels of probiotics and antibiotics in different groups is shown in the Table 3. The cumulative body weight gain of broilers was significantly (P<0.05) influenced during prestarter (0-14d), starter (15-28d) and finisher (29-42d) phases. In the present study prestarter (0-14d) phase showed that there was no significant difference in live body weight between control (107.8g) and probiotic fed (110.8 g) group in first week, whereas there was a highly significant difference in levels of probiotic (267.2) g fed group of prestarter during the second week compared to the control group (236.6 g). During the sixth week there was significant (P<0.05) difference observed among different treatments, highest body weight was observed with probiotic (T3) (2299.1) group followed by combined probiotic and antibiotic (T4) (2178.6) group when compared to the control group (1951.9). The combined probiotic and antibiotic diet followed by probiotic and antibiotic diet showed highest body weight gain (158.7, 154.8 and 148.6 g respectively) than the control group (128.8 g) during the second week of the study. It is observed that in starter (15-28d) phase there was significant (P<0.05) difference in body weight gain among different levels of treatment fed groups. There was a significant

increase in the body weight gain in birds supplemented with probiotic T3 (294.4) group when compared to the control (273.6) group in third week. The cBWG21-42 was significantly highest in probiotic T3 (2259.4) group followed by combined probiotic and antibiotic supplemented (T3) (2138.8) compared to the control (1912.3) group.

In the present study, body weight gain of broilers had been greatly influenced by dietary supplementation of probiotics and their combination. The difference were highly significant (P<0.05) over the control group and such a trend was observable since from 2- 6 weeks of age. The above findings are in agreement with the earlier findings of Talukdar (1992) [32]; Cho *et al.* (1992) [11]; Manickham *et al.* (1994) [23]; Samanta and Biswas (1995) [30]; Kabir *et al.* (2004) [19] and Anjum *et al.* (2005) [2]. The significant (P<0.05) improvement in body weight by feeding the combination of probiotic and antibiotic is in accordance with the earlier findings of Mohan (1991) [24]; Cho *et al.* (1992) [11]; Jin *et al.* (2000) [18]; Bai *et al.* (2012) [8] and Abudabos *et al.* (2015) [1]. However, Fethiers and Miles (1987) [15]; Baidya *et al.* (1994) [9]; Bhatt *et al.* (1995) [10]; Darekar (1997) [12]; Kabir *et al.* (2004) [19]; Gil de los santos *et al.* (2005) [16]; Khaksefidi and Ghoorchi (2006) [21]; Timmerman *et al.* (2006) [33]; Apata (2008) [3]; Awad *et al.* (2008) [5] and Ashayerizadeh *et al.* (2009) [4] observed a contradictory report in body weight. Also Rama Rao *et al.* (2004) [27] observed no significant improvement in body weight with the feeding of probiotic than control. Variability in response to the use of probiotics and combination of probiotics & antibiotics giving good results in terms of weight gain with statistically significant, which may be reasonably due to the bacterial sensitivity, health and hygiene of birds used in the trials as well as the environmental factors.

b. Feed intake and Feed conversion ratio

The present study shows that the data on cumulative feed consumption and feed conversion ratio in broilers as influenced by different dietary treatments is presented in Table 4. The results revealed that during the study there was a significant (P<0.05) difference of feed intake between different groups. There was significant increase in feed intake in probiotic group followed by combined antibiotic and probotics and antibiotic given group when compared to the control group. In the present study, there was significant increase in the FCR in probiotic group followed by combined antibiotic and probiotics and antibiotic given group when compared to the control group. During the second week there was no significant difference in feed conversion ratio between different groups. During the fifth week highest FCR was recorded in combined antibiotic and probiotic (T4) (1.89) group followed by probiotic group (1.87), antibiotic (1.86) and least in control group (1.84).

In the experiment it is observed that the broilers fed with probiotic supplemented diet throughout the experimental period had consumed significantly (P<0.05) more feed as compared to the control group. The results were in accordance with the earlier reports of Tortuero (1973) [34]; Mohan (1991) [24]; Babu (1993) [6]; Manickham *et al.* (1994) [23]; Kalavathy *et al.* (2003) [20] Rama Rao *et al.* (2004) [27]. However, Baidya *et al.* (1994) [8] and Roozbeh *et al.* (2012) [29] observed a contradictory results in feed consumption. The combination of probiotic and antibiotic has significantly (P<0.05) influence on feed consumption as compared to the control group which is in accordance with the findings of Sarmah *et al.* (2014) [31] who observed that the diet supplemented with antibiotic and Probiotic @ 50g/100 kg of feed and a combination of antibiotic and probiotic @ 20 and 25g each/100 kg of feed showed no effect on feed intake. Difference in cumulative feed consumption were observed to be nonsignificant between treatments during 1st, 2nd, 3rd and 5th weeks. Elangovan *et al.* (2011) [13] observed that the probiotics increasing the occurrence of naturally occurring beneficial bacteria in the intestinal tract of birds which may result in the improvement of broiler performance when introduced per unit of feed consumed. Though there were the advantage of better feed efficiency with probiotic and combination of probiotic with antibiotic supplementation, the feed conversion efficiency remained uniform between the treatment groups.

The beneficial effects in cumulative feed conversion ratio is an agreement with the earlier reports of Tullet *et al.* (1987) [35]; Babu (1993) [6]; Baidya *et al.* (1994) [9]; Yu *et al.* (2004) [37]; Anjum *et al.* (2005) [2] and Mountzouris *et al.* (2009) [25]. Better feed efficiency observed in this study with supplementation of probiotic is in accordance with the earlier findings of Cho *et al.* (1992) [11]; and Manickham *et al.* (1994) [23]; Darekar (1997) [12]; Yu *et al.* (2004) [37] who observed significant (P<0.05) difference in feed conversion with probiotic given in drinking water.

The improvement in feed efficiency in this study with combination of probiotic and antibiotic is in agreement with the reports of Babu (1993) [6]; Baidya *et al.* (1994) [9]; Sarmah *et al.* (2014) [31]. But, El- Hammady *et al.* (2014) [14] where the authors observed significant (P<0.05) difference in feed efficiency which might be due to combined effect of probiotic and antibiotic supplementation. The effect of probiotic might be attributable to the probable production of natural antibiotic like acidophil in which is active against pathogenic microbes like *E. Coli* and *Salmonella*. Further the probiotic not only check the growth of pathogenic microorganisms but also could improve the feed utilization with neutralization of toxins and alteration of microbial metabolism. Combination of probiotic and antibiotic supplementation might have resulted in the reduction in gut microflora that compete for nutrients with host and apparently increased the absorption of nutrients.

c. Mortality

The data on the effect of probiotic on mortality (%) is depicted in table 5. The highest mortality (4.36%) was seen in control group. However, the mortality was least in group supplemented with combined antibiotic and probiotic (1.13%) followed by probiotic (1.86%) and antibiotic (3.11%) group.

In this experiment it had been observed that all the treatment groups had comparatively lower percent mortality with that of control indicating a better livability with the supplementation of probiotics/AGP However, the percentage of mortality more in AGP. Mortality was found to be higher in general that is attributed to the summer effect prevailed during the 0-42 days of age. Similar reports were observed by Manickham *et al.* (1994) [23]; Samanta and Biswas (1995) [30]; Upendra and Yatiraj (2002) [36]; Gupta (2004) [17] and Anjum *et al.* (2005) [2].

Table 3: Effect of dietary inclusion of probiotic on Live Body Weight, Cumulative body weight gain (g), feed intake (g) and feed conversion ratio of broiler chicken

LBW (g)				
Age, days	**T1**	**T2**	**T3**	**T4**
0	39.6 ± 0.4	39.5 ± 0.4	39.7 ± 0.3	39.8 ± 0.4
7	107.8 ± 2.9	108.9 ± 4.5	110.8 ± 3.0	115.4 ± 3.7
14	236.6 ± 9.9	258.5 ± 12.7	267.2 ± 14.7	267.0 ± 16.1
21	511.3 ± 27.1	555.0 ± 25.2	563.4 ± 31.8	509.2 ± 38.4
28	939.7 ± 45.2	995.3 ± 41.8	977.1 ± 47.9	984.7 ± 67.9
35	1428.9 ± 56.9	1512.1 ± 61.1	1555.9 ± 46.7	1493.2 ± 90.6
42	1951.9 ± 72.5	2070.0 ± 74.5	2299.1 ± 60.3	2178.6 ± 101.7

BWG (g)				
Age, days	**T1**	**T2**	**T3**	**T4**
BWG0-7	68.2 ± 3.8	69.4 ± 7.4	71.1 ± 3.3	75.6 ± 4.0
BWG7-14	128.8 ± 8.9	148.6 ± 8.1	154.8 ± 12.1	158.7 ± 18
BWG14-21	273.6 ± 20.9	293.3 ± 22.7	294.4 ± 17.7	252.2 ± 42.6
BWG21-28	427.3 ± 27.0	437.1 ± 24.0	412.3 ± 10.0	483.9 ± 40.2
BWG28-35	493.1 ± 41.1	515.4 ± 44.3	585.0 ± 35.9	518.8 ± 31.6
BWG35-42	523.0 ± 46.7	557.9 ± 15.4	743.2 ± 23.8	685.4 ± 78.3
cBWG0-21	470.6 ± 17.4	511.2 ± 32.8	520.3 ± 32.1	486.5 ± 56.6
cBWG0-42	1912.3 ± 90.9	2030.5 ± 25.9	2259.4 ± 44.5	2138.8 ± 146.5
cBWG21-42	1440.6 ± 87.9	1515.0 ± 76.0	1735.7 ± 28.0	1669.4 ± 123.1

Results are expressed as mean ± standard deviation.
BWG: body weight gain; BWGi-i+1: body weight gain calculated weekly; cBWG0-i: cumulated body weight gain calculated for a period of i days; cBWG21-42: cumulated body weight gain determined for the finish period (from day 21 to day 42).

Table 4: Effect of dietary inclusion of probiotic on feed intake (g) and feed conversion ratio of broiler chicken

Feed Intake (g)				
Age, days	**T1**	**T2**	**T3**	**T4**
FI0-7	116.5 ± 7.4	120.8 ± 4.1	144.8 ± 9.4	141.5 ± 22.6
FI7-14	228.8 ± 7.2	265.5 ± 7.2	286.9 ± 19.3	285.5 ± 17.4
FI14-21	446.2 ± 28.9	482.5 ± 49.6	519.4 ± 22.8	483.0 ± 38.0
FI21-28	710.2 ± 23.6	738.5 ± 25.5	834.1 ± 55.5	822.5 ± 68.2
FI28-35	910.6 ± 51.8	958.9 ± 47.2	1094.2 ± 19.7	981.6 ± 50.1
FI35-42	901.8 ± 18.5	980.4 ± 44.2	1320.4 ± 39.1	1211.2 ± 57.8
cFI0-21	801.5 ± 49.1	884.2 ± 29.5	981.0 ± 22.9	894.0 ± 39.0
cFI0-42	3239.8 ± 104.2	3465.8 ± 14.1	3899.8 ± 198.7	3651.4 ± 91.9
cFI21-42	2450.2 ± 80.5	2601.8 ± 11.8	3085.8 ± 161.4	2980.3 ± 68.4
Feed Conversion rate (g/g)				
Age, days	**T1**	**T2**	**T3**	**T4**
FCR0-7	1.7 ± 0.03	1.74± 0.12	2.03 ± 0.09	1.87 ± 0.18
FCR7-14	1.77 ± 0.25	1.78 ± 0.10	1.85 ± 0.11	1.80 ± 0.20
FCR14-21	1.63 ± 0.13	1.65 ± 0.05	1.75 ± 0.08	1.91 ± 0.30
FCR21-28	1.66 ± 0.18	1.68 ± 0.06	2.02 ± 0.09	1.70 ± 0.14
FCR28-35	1.84 ± 0.08	1.86 ± 0.09	1.87 ± 0.10	1.89 ± 0.07
FCR35-42	1.72 ± 0.14	1.75 ± 0.05	1.78 ± 0.03	1.77 ± 0.19
cFCR0-21	1.70 ± 0.06a	1.72± 0.05b	1.88 ± 0.05ab	1.84 ± 0.16a
cFCR0-42	1.69± 0.04	1.70 ± 0.05	1.73 ± 0.01	1.71± 0.06
cFCR21-42	1.70 ± 0.07	1.71± 0.06	1.77 ± 0.03	1.78 ± 0.08

Results are expressed as mean ± standard deviation.

Table 5: Effect of dietary inclusion of probiotic on mortality (%)

Mortality (%)				
Age, days	**T1**	**T2**	**T3**	**T4**
0-7	3.13	1.25	0.62	0.00
7-14	0.0	0.62	0.0	0.52
14-21	0.0	0.62	0.62	0.0
21-28	0.0	0.0	0.62	0.0
28-35	0.61	0.0	0.0	0.0
35-42	0.61	0.61	0.0	0.61
0-42	4.36	3.11	1.86	1.13

Table 6: Effect of dietary inclusion of probiotic on mortality (%)

Diets	RCY*	Heart	Liver	Gizzard	Intestin al wt.	Abdominal fat	Breast Yield
T1	66.67	0.367	2.207	1.929	3.346	1.634	17.99b
T2	72.55	0.439	1.904	1.741	3.394	1.629	16.38a
T3	74.52	0.371	2.348	1.641	4.146	2.283	14.46a

T4	71.65	0.414	2.134	1.843	3.137	2.018	17.81ab
N	6	6	6	6	6	6	6
P Value	0.111	0.206	0.519	0.294	0.146	0.327	0.021
SEM	1.0138	0.0134	0.0640	0.0405	0.1251	0.1165	0.3714

II. Carcass Yields

The present experiment shows that the data obtained on different carcass parameters were influenced by different treatments are presented in Table 6. The present experiment reveled that there is no significant difference was observed statically between control and various experimental groups. However, the values ranged between (66.67 to 76.14%) for ready to cook yield similarly the heart weight ranged between (0.367 to 0.469%) and liver (1.904 to 2.348%), gizzard (1.661 to 1.929%), intestinal weight 3.137 to 4.146 and abdominal fat 1.553 to 2.283 respectively. The supplementation of combination of probiotics and antibiotics improved the breast yield. There is significant (P<0.05) difference was observed statistically between control and various experimental groups.

All dietary groups failed to exert any significant influence on carcass parameters like dressing yield, eviscerated yield, ready to cook yield and giblet yield (liver, heart and gizzard) except breast yield which was significantly (P<0.05) different among the treatments. The reports of Babu (1993) [6]; Rameshwar *et al.* (1994) [28]; Baidya *et al.* (1994) [9] and Darekar (1997) [12] showed that they did not show any significant(P>0.05) influence on carcass parameters of broilers. On the contrary, probiotics Lee *et al.* (1993) [22]; Pelicano *et al.* (2003) [26]; Roozbeh *et al.* (2012) [29] reported that the addition of probiotics had significant (P<0.05) effect on carcass parameters of broilers. Ashayerizadeh *et al.* (2009) [4] reported that the breast yield significantly (P<0.05) more in broilers fed the diet supplemented with probiotic compared to the birds fed either prebiotic or symbiotic.

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