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Improvement in growth performance of broiler chicken on dietary supplementation of mushroom powder (*Agaricus bisporus*) and probiotics (*Saccharomyces cerevisiae*)

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Abstract
A study was conducted to evaluate the effect of mushroom (*Agaricus bisporus*) and probiotics (*Saccharomyces cerevisiae*) on broiler performance. Day-old broiler chicks (n=360) of strain (Cobb 400) were divided randomly into eight groups. Each represented a treatment (45 birds/ treatment) with triplicate in a completely randomized design. The experimental diets were designed as, T_1: control, T_2: 0.4% mushroom powder, T_3: 0.8% mushroom powder, T_4: 1.2% mushroom powder, T_5: 0.1% probiotics, T_6: 0.2% probiotics, T_7: 0.3% probiotics and T_8: 0.8% mushroom powder + 0.2% probiotics levels. The results showed that the average body weight was significantly higher in (T_4) group compare to control diet. The highest gain in the body weight was observed in the probiotics supplemented group (T_5) and the lowest mean body weight gain was recorded in (T_7) group. The lowest feed consumption was noticed in the control group (T_1) which was appreciably ($P<0.01$) lower than treatment group. Best FCR was observed in (T_4) mushroom treated group. Therefore, the supplementation of mushroom and probiotics at different level, improved the growth performance in commercial broiler.

Keywords: Broiler, feed, mushroom, growth, performance, probiotics

Introduction
Keeping poultry makes a real contribution to household food security throughout the developing world. It helps diversify incomes and provides quality food, energy, fertilizer and a renewable asset in over 80 percent of rural households. Poultry production in India has taken a quantum leap in the last four decades, emerging from an entirely unorganized and unscientific farming practice to a commercial production system with state-of-the-art technological interventions. Indian commercial poultry sector has advanced remarkably due to a scientific approach adopted by the industry and an enabling environment created by the Government. The Indian Poultry Sector is broadly divided into organized and unorganized sub-sectors. Needs for the subsectors are very different. Government of India is catering to the needs of the subsectors through development programs of Poultry Development and for entrepreneurship development. Central Poultry Development Organizations are playing a pivotal role in the coordination and dissemination of these developmental programs of the Government.
According to the FAO (2012) [5], the demand for poultry meat has consistently increased at around three times the rate of population growth over the past five decades. High growth rate of poultry industry is on account of its low capital investment, early assured returns, short generation intervals and limited land requirements. Today, it is a highly specialized, complex competitive business, characterized by a phenomenal growth and has become one of the fastest growing segments of the agricultural sector in India. Mushrooms (*Agaricus bisporus*) are fruiting bodies of fungi that are known to offer several benefits such as fast growth, improved health and increased resistance and protection from pathogens (Guo *et al.*, 2003) [9]. This fungal kingdom possesses certain natural advantages in terms of their dietary superiority over the rest of the vegetarian platter like (a) good protein content (20%–30% of dry matter) with all the essential amino acids, making them capable of substituting for meat; (b) chitinous wall to act as a source of dietary fiber; (c) high vitamin B content; (d) low-fat content; and (e) almost no cholesterol (Ghorai *et al.*, 2009) [7]. Total lipid content varies between 0.6% and 3.1% of the dry weight in the commonly cultivated mushrooms; the adverse effects of hot

weather on the growth performance of broilers are overcome by using Mushroom *(Agaricus bisporus)* and probiotics. Most studies that have evaluated the addition of mushrooms to bird diets have emphasized the micro biotic effects and changes in animal performance.

Probiotics is a live microbial food supplement that benefits the host animal by improving its intestinal microbial balance (Isolauri *et al*., 2001) [10]. These health-promoting bacteria are increasingly being used in poultry feed in place of antibiotics as an alternative approach to controlling the growth of unfavorable microorganisms. Jernigan *et al*. (1985) [11] defined probiotics as culture of specific living microorganisms which implant in animal to which they are given ensures effective establishment of intestinal microbial population.

Materials and Methods

The experiment was conducted at the Poultry Research and Training Center under the Department of Animal Husbandry, Sardar Vallabhbhai Patel University of Agriculture & Technology, Modipuram, Meerut-250110. The experiment included day-old broiler chicks (n=360) of strain were divided into 8 groups (n=45): control (T_1) and experimental groups (T_2, T_3, T_4, T_5, T_6, T_7 and T_8). Standard feed was prepared and used throughout the experimental study. Composition of the experimental starter and finisher diets fed to broilers are shown in Table 1 and proximate composition of starter and finisher feeds of broilers are shown in Table 2. Mushroom powder and probiotics were incorporated into the experimental diets manually in appropriate dosage. Cross mixing was applied during the time of mixing. Mixing was done manually and no coccidiostat or any other feed additives were added to the formulated diets to get clear-cut effect of the test-diet. Mushroom powder and probiotics were added to the experimental diets (except control diet) at required amount according to each treatment. The chicks were provided feed according to their requirements as per the NRC, 2001 specifications. For the first three days of brooding, feed was provided on the newspaper spread of rice husk and sufficient water provided in water troughs and afterwards, linear chick feeders were used up to 14 days, feed residues were collected and weighed at weekly interval. During the finishing phase hanging feeders were used. Feed and water troughs were regularly cleaned to reduce the contamination. The rations were changed after 21 days from 22% CP for starter feed to 20% CP for grower/finisher feed for the rest of the time until days 42. The experiment was conducted over a period from 2nd April 2019 to 14th May 2019.

Results and Discussion

Mushroom and Probiotics supplementation resulted in improvement of the poultry growth due to a great efficiency in the utilization of feed. It is well established that, probiotics have digestion stimulating properties and anti-microbial establishing ability due to multiplications of beneficial microorganisms in the gut. As results shows in (Table 3) the body weight of broiler chicks at different age from 1st to 6th week was significantly higher in all mushroom and probiotics supplemented groups compared to the control group. Supplementation of mushroom powder at the highest level (T_4) had increased ($P<0.01$) body weight significantly. However, body weight, on other hand, was lower ($P<0.01$) in control group (T_1). The findings of the present study are in accordance with the work of Giannenas *et al.* (2010) [8], who observed significant improvement in live body weight of broiler fed on diet supplemented with 10 or 20 gm of dried mushroom/kg of feed for 6 week on *ad libitum* basis. Ebenebe *et al.* (2011) [4] also recorded highest live weight in birds fed with 2% mushroom and 2% paw-paw leaves compared with control group. The present results also obtained are in accordance to the findings of Toghyani *et al.* (2012) [16] who observed that diet supplementation with mushroom powder, particularly at 20 g/kg inclusion rate, improved body weight and feed efficiency of broilers at younger age. The results of body weight gain are presented in (Table 3). The body weight gain of broiler birds at different ages from day old to the 6th week were found to be significantly ($P<0.01$) affected by treatments. The body weight gain was higher ($P<0.01$) in chickens received the highest level of probiotics (T_5) compared to the rest of dietary treatments. The finding of the present study are in accordance with the work of Shareef and Dabbagh, (2009) [15] who reported that *Saccharomyces cerevisiae* supplementation of broilers, to the level of 1, 1.5 and 2%, were significantly, increased the body weight gain, improved feed consumption and feed conversion efficiency. The beneficial effect of *Saccharomyces cerevisiae* is attributed to that it is a naturally rich source of proteins, minerals and B-complex vitamins. Zhang *et al*. (2005) [19] reported that body weight gains were linearly ($P<0.01$) increased in birds fed with 0.3, 1.0 and 3.0% *Saccharomyces cerevisiae*, respectively, when compared with those fed with the basal diet without *Saccharomyces cerevisiae*. Zhang and Kim (2014) [20] reported an overall increase in body weight gain in chicken fed with multistrain probiotics compared with that in control group fed basal diet. Chang *et al*. (2001) [2] who reported that probiotics promote growth in farm animals by breaking down the hydrocarbons contained in the diet, which means the food is being split into its most basic elements. This allows almost total absorption through the digestive system. In this way, probiotics dramatically increased overall nutrition and enhance rapid cellular growth and development. Gao *et al.* (2008) [6] observed that dietary supplemental, yeast culture at 0.25% improved average daily gain and feed efficiency during grower and overall periods in broilers ($P<0.05$). Similarly, Willis *et al.* (2007) [18] found an improved body weight gain of broilers with the supplementation of mushroom extract to 21 day of age. However, this supplementation did not sustain improved weight gains up to d 49 when the trial was completed. The result of feed consumption of broiler chicks is presented in (Table 3). The feed consumption was significantly higher ($P<0.01$) in chickens received the highest level of probiotics (T_5) compared to the rest of dietary treatments. The finding of the present study are in accordance with the work of Kavyani *et al*. (2014) who observed the highest daily feed intake in the groups receiving mushroom in their diet. Increase feed intake in broiler giving mushroom as feed additive compared to control was also observed by Giannenas *et al.* (2010) [8]. The results obtained in this experiment are in concurrence with Kumprecht *et al*. (1994) [13] as they studied the effects of Saccharomyces cerevisiae var. elipsoideus and Streptococcus faecium C-68 (SF-68) as probiotics on broilers and reported improved feed intake and FCR.

Mazaheri *et al.* (2014) [14] also investigated the effect of diets of mushroom waste in broiler diets and observed increase in the feed intake. Broiler chickens that received mushroom waste at 6% level had a significantly higher feed intake than

those birds fed on a control diet ($P>0.01$). Supplementation of probiotics to broiler diet had no significant effect on feed intake. The result of feed conversion ratio of broiler chicks is presented in (Table 3). Mushroom supplemented (T_4) was having significantly ($P<0.01$) better FCR than all other treatments. There was a non significant difference ($P>0.01$) between mushroom group (T_3), probiotics group (T_7) and composition of mushroom and probiotics group (T_8) as well as between (T_5, T_6) group, although there were significant difference among T_1, T_2, T_3, T_4, and T_5 ($P<0.01$). Among all, the poor FCR was observed in control group (T_1). These results were equally in conformity with the finding of Aluwong *et al.* (2013) has reported that the broilers fed a higher dosage (>1.0%) of *Saccharomyces cerevisiae* diets gave higher ($P<0.01$) body weight, low FCR compared to the broilers fed low dosage of *Saccharomyces cerevisiae* at day 35. Upendra, (1999) [17] recorded the much improved weight gain in *Sac. Cerevisiae* supplemented group on day 14, 28 and 42 and improved FCR by 11.42 per cent by the end of 42nd day experimental trial.

The result of feed conversion efficiency of broiler chicks is presented in (Table 3). There were no significant difference among mushroom group (T_3), probiotics supplemented group (T_7) and composition of mushroom and probiotics supplemented group (T_8) as well as between (T_5, T_6) group, although there were significant difference among T_1, T_2, T_3, T_4, and T_5 ($P<0.01$). The findings of the present study in accordance with the work of Giannenas *et al.* (2010) [8] who reported that improved feed efficiency when broiler ration supplemented with 10 or 20 gm of dried mushroom/kg of feed for 6 week on ad libitum basis. The dietary mushroom (*Agricus bisporus*) inclusion significantly ($P<0.01$) improved feed conversion efficiency of broilers in M10 and M20 groups as compared with control. This observation agrees with the earlier reports of Toghyani *et al.* (2012) [16] also indicated that inclusion of mushroom powder at the level of 20 g/kg of diet had favorable effects on feed efficiency of chicks reared to 28 days of age. Similar to the current result, Daneshmand *et al.* (2011**)** [3] also reported that inclusion of oyster mushroom powder at a very low inclusion level of 0.2% did not bring about a significant effect on FCR.

Table 1: Composition of the experimental starter and finisher diets fed to broilers

S.N.	Feed ingredients	Amount (kg/100kg feed)		
		Pre-Starter (1 to 14days)	Starter (15 to 27days)	Finisher (28 to 42days)
1	Maize	36.00	37.00	39.00
2	Rice Polish	34.00	35.00	38.00
3	Soybean Meal	9.00	9.00	7.00
4	Groundnut Cake	9.00	8.00	7.00
5	Fish Meal	9.00	8.00	6.00
6	Mineral Mixture	2.00	2.00	2.00
7	Common Salt	1.00	1.00	1.00
	Total	100.0	100.0	100.0

Table 2: Proximate composition of Starter and finisher feeds

S. No.	Chemical constituents	Pre Starter feed	Starter feed	Finisher feed
1.	Moisture	10.01	10.40	9.80
2.	Dry Matter	89.99	89.60	90.20
3.	Ash	6.59	5.20	5.38
4.	Organic Matter	93.41	94.80	94.62
5.	Crude Protein	22.75	22.50	20.00
6.	Ether Extract	4.36	4.75	4.851
7.	Calcium	0.96	0.98	0.97
8	Phosphorus	0.65	0.45	0.40
9	Metabolisable Energy (Kcal/Kg)	3250	2810	2890

Table 3: The effects of feeding different levels of mushroom and probiotics on average body weight/ average body weight gain, feed consumption, feed consumption efficiency and feed conversion ratio (FCR) (grams/bird/week) of broiler chicks

Treatment	Average Growth Performance (gm/bird)					
	Initial body weight	Final body weight	Body weight gain	Feed consumption	Feed consumption Efficiency	FCR
T_1: Control Group	39.67	1795.53^{a}	414.07^{b}	3465.48^{a}	0.51^{a}	1.97^{e}
T_2: 0.4% Mushroom Powder	40.44	1857.02^{b}	413.67^{b}	3473.71^{a}	0.52^{b}	1.91^{d}
T_3: 0.8% Mushroom Powder	39.82	1944.11^{d}	444.09^{c}	3470.39^{a}	0.55^{d}	1.82^{b}
T_4: 1.2% Mushroom Powder	39.51	2007.38^{f}	428.76^{bc}	3473.56^{a}	0.57^{e}	1.77^{a}
T_5: 0.1% Probiotics (SC)	40.45	1918.44^{c}	504.13^{d}	3513.78^{d}	0.53^{c}	1.87^{c}
T_6: 0.1% Probiotics (SC)	40.31	1910.29^{c}	428.02^{bc}	3491.02^{b}	0.54^{c}	1.87^{c}
T_7: 0.1% Probiotics (SC)	40.33	1976.36^{e}	381.00^{a}	3503.12^{cd}	0.55^{d}	1.81^{b}
T_8 0.8% Mushroom Powder+ 0.2% Probiotics (SC)	40.33	1981.87^{e}	484.78^{d}	3493.84^{bc}	0.56^{d}	1.80^{b}
SEM	0.23	8.51	8.94	4.10	0.003	0.008
P-value	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01

a,b,c Means with different superscripts within the same column are significantly different ($P<0.01$); SEM: standard error of mean. Treatment: T_1 (control) = not supplemented; T_2= 0.4% mushroom powder; T_3 = 0.8% mushroom powder; T_4= 1.2% mushroom powder; T_5= 0.1% probiotics, T_6= 0.2% probiotics, T7=0.3% probiotics and T8=0.8% mushroom powder+0.2 percent probiotics

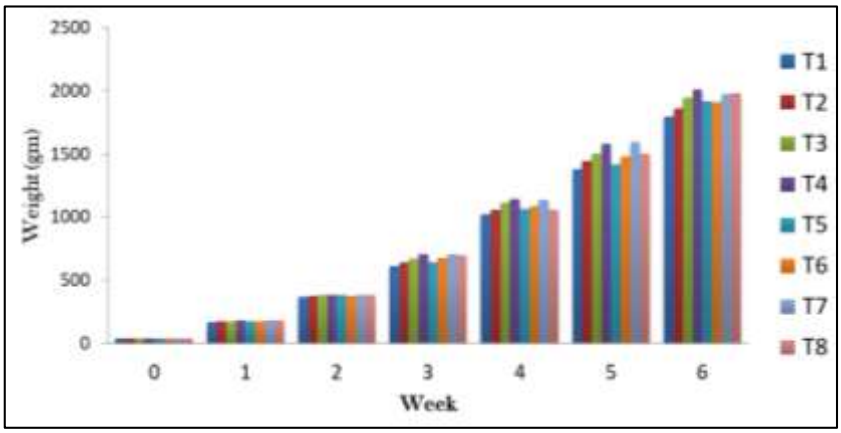

Fig 1: The effects of feeding different levels of mushroom and probiotics on average body weight (grams/bird/week) of broiler chicks

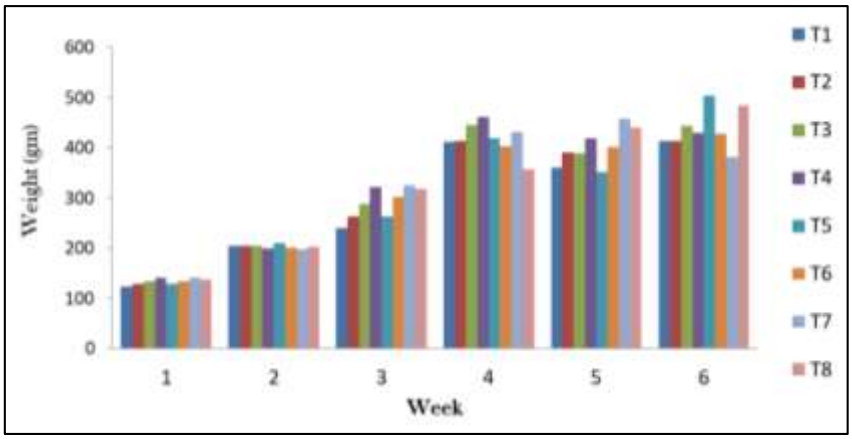

Fig 2: The effects of feeding different levels Effect of mushroom and probiotics on average body weight gain (gram /bird/week) of broiler chicks

Conclusion

Supplementation of mushroom and probiotics at different level improved the growth performance in commercial broiler. However, body weight, feed conversion ratio and feed conversion efficiency improved in broiler groups supplemented with mushroom as compared to control. Total body weight was found to be significantly higher in mushroom supplemented group T_4 in comparison to all other groups. Overall body weight gain was found higher in probiotics supplemented group (T_5) than other groups. Average body weight gain of all supplement groups were higher and differed significantly ($P<0.01$) from control group. Mushroom supplemented (T_4) was having significantly ($P<0.01$) better FCR than all other groups. The highest FCE was observed in mushroom powder supplemented group (T_4) and lowest in the control group (T_1). Growth performance of broiler chicken was improved with supplementation of different levels of mushroom powder and probiotics

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