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Effect of Dried Mushroom Supplementation on Muscles Composition, Nutrient Utilization and Economics in Broiler Chicken

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

The experiment was conducted at poultry farm of Chandra Shekar Azad University, Kanpur during summer season of date.. to assess the muscles composition, nutrient utilization and economics on feeding dried mushroom to broiler chickens. Broiler chicken supplemented with the edible *P. florida*

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mushroom, 20g/kg of dried *P. eoes* mushroom, and 20g/kg of dried *P. sajor caju* mushroom. Day-old broiler chicks from a single hatch were weighed individually and divided into 4 groups of six birds each at random. The birds were given a basic diet for starter and finisher rations for 0–3 and 4-6 weeks, respectively. One group (G1) was kept as the control, while the remaining three groups (G2, G3, and G4) given their chicks the same basic food as G1 combined with various types of mushrooms. Groups G2, G3, and G4 were fed 20g/kg of dry *P. florida* mushroom, 20g/kg of dried *P. eoes* mushroom, and 20g/kg of dried *P. sajor caju* mushroom. Throughout the six-week testing period, food and drink were freely available. Feed consumption, Muscles composition and nutrient utilization values were monitored weekly. Economics was also calculated. It was found that, muscles composition highest in G3 whereas nutrient utilization and benefit cost ratio highest in G2. The application of *Pleurotuus* sp.mushroom (*P. florida*, *P.eoes*, and *P.sajor* caju respectively) in different groups in the diet of broiler chicks improved the growth rate in summer season. The *Pleurotous florida* mushroom is therefore required for an improvement in growth performance during the summer.

Keywords: Broiler; feed; pleurotus mushroom; proximate analysis.

1. INTRODUCTION

The poultry firm is a part of agriculture that is expanding very rapidly. Poultry is one of the fastest-growing segments of the agricultural sector in India, with an average growth rate of 8-10% per annum [1]. About 70 to 80 percent of the entire cost of production in the production of poultry is spent on feed. Therefore, economy in feed expenses can bring better return to poultry farmers. India now ranks 5rd largest country for egg production. Annual growth rates are now 8.35% for broiler industry. India is the 6th largest producer of poultry meat in the world [2], producing about 3.9 million ton of poultry meat in 2020-21. With the advancement in science and knowledge of people, the animal sector in our country gained momentum. A remarkable aspect about poultry is that it is in an efficient converter of low fibre feed stuffs into highly nutritive animal protein for human consumption.

In many countries, poultry farming has grown to be a significant economic sector. When diseases and environmental conditions worsen in large-scale rearing facilities where poultry are subjected to stressful circumstances, there are significant financial losses. The usage of veterinary pharmaceuticals has significantly increased during the past few decades as a result of disease prevention and control measures. However, significant research on the development of antibiotic resistance among harmful microorganisms is useful. Therefore, there is an environment where both the consumer and the manufacturer are looking for alternatives due to the potential that antibiotics won't be employed as growth promoters for chicken and the concern over their usage as therapeutic agents. The nutritionist has been compelled to develop and give an economical diet in order to assure optimum performance due to the unheard-of rising increase in feed prices, which alone represents around 75% of the cost of broiler production. Due of the negative impact on consumers, the use of chemical feed additives as growth promoters to reduce feed and production costs by boosting feed efficiency has come under fire. With so many breakthroughs in the "No Chemical Era" the knowledge of herbs and their medicinal properties had made forays in the poultry industry and attracted to quantify reliable effects for maximizing better production in poultry without residual toxicity as side effects on consumers. Typically, herbal growth enhancers are liver tonics that enhance the bird's hepatic functions.

They contribute to better feeding, amino acid synthesis, and aflatoxin reduction, all of which improve broiler performance. Feeding of herbal promoter improves the protein content with the significant decrease in blood cholesterol level. Due to the rising demand for poultry meat, breeders, nutritionists, and growers are under pressure to improve bird growth rates, feed efficiency, breast muscle size, and stomach fatness. Numerous studies have shown that fast-growing strains have higher rates of spontaneous or idiopathic myopathies (such as deep pectoral muscle disease) and are more susceptible to stress-induced myopathies, which may have significant effects on the quality of the meat and the frequency of abnormal conditions like pale, soft, and exudative (PSE)-like meat. In addition, it is thought that selection for muscle growth has increased issues with toughness and

poor cohesion, colour, and water retaining characteristics in meat.

The annual growth for meat production 2020-21 was 9.62%. With production expected to reach a record 4.8 million tonnes in 2020, India's broiler production growth is predicted to increase by 7.85 percent annually. With an estimated 7% annual average growth, the broiler industry is characterized by robust but unstable growth. Around 3.1 kg of poultry meat are consumed annually per person in India, with chicken becoming the most popular non-vegetarian protein choice. Poultry farming is employed by about 1 million farmers, 85% of whom have less than 2 ha of land or are landless. Poultry production in India now tops all other subsectors with 851.8 million birds produced annually. With an anticipated production of 103.3 billion eggs and 4.1 million tonnes of grill meat, India is the world's fourth-largest producer of eggs and grill meat [3]. The upsurge of a wide range of diseases and bacterial resistance have both been brought on by the increased productivity in the chicken companies. Probiotics are used to prevent bacterial infections in poultry and to show how they may affect their immune system, growth, and performance. Dressed poultry meat is also shown to be safe and healthy, protecting the consumer. It has long been recognized that mushrooms are a significant source of bioactive substances with therapeutic potential.

Extracts made from different mushrooms are particularly interesting because they are known to impart health-promoting advantages because they include a variety of antioxidant-rich chemicals. According to recent reports, Chinese herbal and mushroom extracts used in combination with Chinese antibacterial, immune-boosting, and stress-reducing qualities can function as an alternative to antibiotic growth promoters in grill chicken [4]. Pleurotus ostreaus and Ganoderma lucidium, two edible and therapeutic mushrooms, are used in Asia and several tropical African countries to enhance many aspects of human health and immunological function in specific medical circumstances [5]. Similar to probiotics, mushrooms are natural ingredients that contain bioactive chemical compounds or polysaccharides proteins, unprocessed fibres, unsaturated fats, minerals, vitamins, essential amino acids, organic acids, and antioxidants. These nutrients make mushrooms suitable as a source of supplemental food as well as a form of medicine to improve health and productivity. Natural antioxidants that may take the place of synthetic ones and satiate customer expectations for food products devoid of residues from compounds that have the potential to impair human health would be much appreciated by the poultry business. While the phenolic antioxidants variegate acid and dibiviquinoine are also present in mushrooms, ergothionine has been isolated and quantified as the primary antioxidant ingredient in several genera of mushrooms. Keeping the above facts in view, the present study entitled as "Assessing the effect of dried mushroom supplementation on muscles composition, nutrient utilization and economics in broiler chicken" was undertaken.

2. MATERIALS AND METHODS

The experiment was conducted at poultry farm of Chandra Shekar Azad University, KANPUR during summer season. The climate of Kanpur is semi-arid and sub-tropical type. Geographically, Kanpur is situated at 26 29' 25" nor the latitude and 80 18' 25" east longitude. The elevation of Kanpur from sea level is 125.9 mt. In this experiment, day-old broiler chicks from a single hatch were weighed individually and divided into 4 groups of six birds each at random. The birds will be given a basic diet for starter and finisher rations for 0–3 and 4-6 weeks, respectively. One group (G1) was kept as the control, while the remaining three groups (G2, G3, and G4) given their chicks the same basic food as G1 combined with various types of mushrooms. Groups G2, G3, and G4 were fed 20g/kg of dry *P. florida* mushroom, 20g/kg of dried *P. eoes* mushroom, and 20g/kg of dried *P. sajor caju* mushroom. Throughout the six-week testing period, food and drink were freely available.

2.1 Duration of Study

The experiment was carried out for 42 days on broiler chickens at Chandra Shekhar University of Agriculture and Technology, Poultry Farm, Kanpur in summer season 17th February to 29th march.

2.2 Management and Housing

The broilers of group G_1, were fed according NRC feeding standard (1985). This group was used as a controlled feeding, whereas the chicks in group G_2 were fed with dried mushroom. G_3 *P. florida*, and G_4 *P.sajora caju* respectively.

A weighed quantity of ration was offered individually to the experimental animals twice in a day once in morning at 8:30 AM and again in evening 4:30 P.M and water was offered thrice daily in the morning at 8:30 A.M and in afternoon 1:00 P.M and again in evening 6:00P.M.

2.3 Weight of Chicks

Body weight was recorded for 42 days at weekly intervals Weighing of the animals was carried out before feeding and watering at 8: 00A.M only.

2.4 Chemical Analysis of feed, Residues and Faeces

During present investigation analytical techniques followed for the estimation of dry matter and for other ingredients and proximate principles those recommended [6,7].

2.5 Statistical Analysis

Calculation of mean, standard error and analysis of variance has been carried out according to the method described by Snedecor and Cochran 1968 [8]

3. RESULTS AND DISCUSSION

3.1 Muscle Composition

During summer season average mean value of muscle were 73.50, 73.81, 73.88 and 73.74 per cent in G_1, G_2, G_3 and G_4, respectively (Table 1, Fig. 1). It recorded the significant difference were founded in different among group ($p<0.05$ C.D. 0.05) The highest muscle value was found in G_3 followed by G_2, G_4 and G_1, respectively. The G_3 was significant higher from all the group whereas all group showed difference from each other.

Protein: The mean value of protein was 17.74, 18.02, 17.92 and 17.90 in G_1, G_2, G_3 and G_4 respectively (Table 1, Fig. 1). It recorded the significant difference were found in different group ($p<0.05$ C.D. 0.040). The higher value was found in G_2 followed by G_3, G_4 and G_1, respectively. The G_2 was observed significantly highest from all other groups whereas all the other group whereas all other group were difference from each other.

Fat: The average value of fat was 5.79, 5.94, 5.89 and the 5.87 in G_1, G_2, G_3 and the G_4 is respectively (Table 1, Fig. 1). It recorded the significant difference were founded among different group ($P<0.05$ C. D. 0.003). The highest was found in G_2 followed by G_3, G_4 and G_1, respectively. The G_2 was observed significantly highest from all other groups whereas all other groups did not showed difference from other except control group. During summer season (Table 1, Fig. 1) the muscle composition in bird in G_1, G_2, G_3 and G_4 was 73.50, 73.81, 73.74 and 73.74 per cent in moisture; 17.74, 18.02, 17.90 and 17.89 in protein; 5.79, 5.94, 5.89 and 5.87 in fat. The overall results showed significant difference in proximate per cent composition of muscle between the treatment and control.

Table 1. Composition of broiler ration

Ingredient	Starter ration	Finisher ration
Yellow maize	60.0(g)	61.50(g)
Wheat bran	6.00(g)	10.75(g)
Soya bean meal	22.00(g)	18.50(g)
Fat	1.00(g)	1.00(g)
Fish meal	8.00(g)	2.25(g)
Mineral mixture	2.00(g)	2.25(g)
Common salt	0.25(g)	0.25(g)
Vitamin mixture	0.25(g)	0.50(g)
L-lysine	0.15(g)	0.10(g)
DL- methionine	0.10(g)	0.15(g)

Table 2. Chemical composition of ration fed to different groups (%)

Feed offered	D.M.	Ash	C.F.	C.P.	E.E.	N.F.E.
Starter	83.56	4.2	6.0	22.50	1.45	65.50
Finisher	85.46	3.3	8.5	19.72	1.83	67.03

An experiment to an antibiotic, in terms of their effect on nitrogen and amino acid digestibility. Two digestibility trials and one performance trial were conducted. Trials one and two apparent nitrogen (AND) and amino acid (AAD) digestibility were determined from digesta collected at the terminal ileum (ileal digestibility method). It can be concluded that Bio-Mos®, Acid-Pak 4-way®, as well as MCT can be a possible alternative to antibiotic supplementation. These three treatments did not necessary prove to be more effective than antibiotics, but are definitely competitive alternatives [9].

3.2 Nutrient Utilization

Dry matter: The digestibility of dry matter was 59.32, 62.21, 59.54 and 59.20 in G_1 G_2, G_3 and the G_4 respectively (Table 4, Fig. 2). It recorded the significant difference were founded among different group ($p<0.05$ C.D. 0.95). The highest value was founded in G_2 followed by G_3, G_1 and G_4 respectively. The G_2 was observed in significantly highest from all other group whereas G_1 and G_4 groups did not showed difference from each other.

Crude protein: During summer season digestibility of CP were 63.65, 66.16, 65.84 and 65.75 in G_1, G_2, G_3 and the G_4 respectively The data indicated the significant difference were found among different groups ($p<0.05$ C.D. 0.016). The highest weight observed in G_2 followed by G_3, G_4 and G_1. G_4, G_2 and G_3 shoe did not differ from each other while control group differ from each treatment group.

Table 3. Effect of *Pleurotus sp.* mushroom on muscle composition of different groups of broilers in summer season

Parameters	G_1	G_2	G_3	G_4	Mean
Muscle	73.50	73.81	73.88	73.74	73.73
Protein	17.74	18.02	17.92	17.90	17.89
Fat	5.79	5.94	5.89	5.87	5.87
Mean	32.34	32.59	32.56	32.50	
Factor	**C.D.**		**S.E. (d)**		**S.E (m)**
Muscle	0.42		0.21		0.15
Protein	N. S		0.24		0.17
Fat	N. S		0.42		0.30

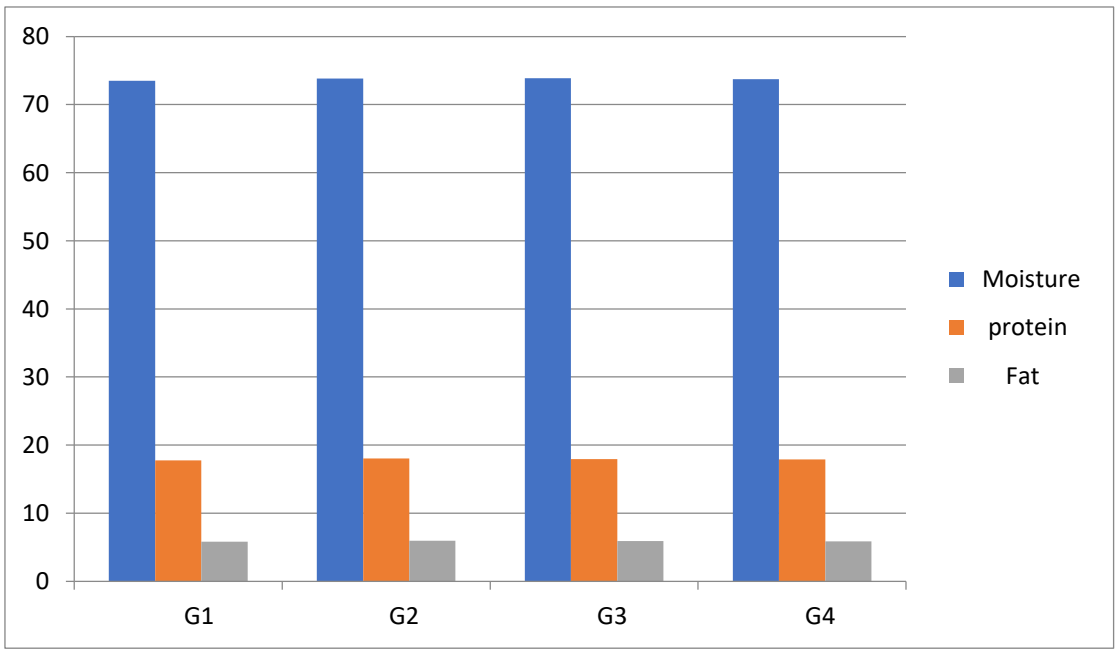

Fig. 1. Muscles composition of different groups of broiler chickens

Crude fibre digestibility: The digestibility of C.F are 36.86, 45.66, 45.55 and 45.50 in G_1, G_2, G_3 and the G_4 respectively It recorded the significant difference were found among different group ($p<0.05$: C.D. 0.24). The significantly highest from all other groups whereas all the other groups whereas all the other groups did not showed difference from each other. The highest value was found in G_2 followed by G_3, G_4 and G_1, respectively. The G_2 was observed significantly highest from all other groups whereas G_3 and G_4 group did not showed difference from each other.

Either extract digestibility: The digestibility coefficient of EE are 60.05, 61.58, 61.50 and 60.45 in G_1, G_2, G_3 and G_4 respectively It recorded the significant difference were found among different group ($P<0.05$: C.D. 0.08) significantly second highest from all other groups. Whereas all other group did not showed difference from each other. The highest value was found G_2 followed by G_3, G_4 and G_1, respectively. The G_2 was observed significantly highest from all other groups. All other groups showed difference from each other.

Nitrogen free extract digestibility: The average value of NFE were 79.64, 81.25, 80.67 and 80.55 in G_1, G_2, G_3 and G_4 respectively The significant difference was observed among different groups ($p<0.05$; C.D. 0.04) The NFE was observed in G_2 followed by G_3, G_4, and G_1, respectively. All the group showed difference found in each other. During summer season (Table 4) the nutrient utilization per bird in G_1, G_2, G_3 and G_4 was 59.32, 62.20, 59.54, 59.30 in dry matter; 63.65, 66.16, 65.84 and 65.75 in crude protein; 36.86, 45.66, 45.55 and 45.50 in crude fibre; 60.05, 61.58, 61.50 and 60.45 in ether extract; 79.64, 81.20, 80.65 and 80.55 in nitrogen free extract respectively.

Higher nutrient digestibility and retention were observed in treatment groups and statistical analysis revealed significant difference ($p < 0.05$) between treatments and control. These values did not differ significantly among various treatment groups. The percentage nutrients utilization was higher in *P. florida* mushroom supplemented group. The result was similar to Elsamahy et al. [10] due to the increase in cost of raw materials and concentrates at the last few years so we must complete use of its component by adding probiotics (Pro) or Prebiotics (PRE) to the effect of pathogenic microbes which causes diarrhea, lower immunity and lower net return of poultry projects. Lower crude fat contents were observed in fillet tissues of 5.0–20.0 g/kg PESR (*Pleurotus eryngii* stalk residue (PESR) is a byproduct of the edible portion of the fruiting body) groups when compared with the control group. Thus, PESR may potentially be used as an antioxidant to decrease lipid peroxidation and improve meat quality in broilers [11]. Supplementation of 900 mg L-carnitine in diet with added animal fat had no effect on growth performance, nutrient utilization, and nitrogen balance of broilers [1].

3.3 Economic

During the summer season the data revealed the average value of profit\ bird 17.75, 16.96, 15.55 and 21.15 in G_1, G_2, G_3 and G_4 IRs respectively. It clearly shows the cost and benefit ratio increases in G_2 followed by G_3, G_1, and G_4. To find out cost of production the feed required per Kg weight gain in the entire group was calculated. In group G_2, G3 and G_1 we have added the cost of *Pl.florida* mushroom*, Pl.eoes* mushroom*, Pl.sajor caju* was added @12.00 per kg of feed respectively. Cost of feed per bird was found Rs.63.60, Rs60.07, Rs68.75 &65.77 in G_1, G_2, G_3 and G_4, respectively. The data revealed the average value of profit/bird were 15.12, 20.04, 16.81 and 12.57 in G_1, G_2, G_3 and G_4, respectively. It clearly shows that cost and benefit ratio increase in G_2 followed by G_3, G_1 and G_4. An experiment to study the effect of combined supplementation of probiotic and yeast on growth, carcass traits, organ weights and production in commercial broiler chickens from 0 to 6 weeks of age. Findings of the present study suggested that supplementation of probiotic and yeast mixture @ 1.0g/kg diet was effective in improving economics in broiler chickens [12]. An experiment conducted where birds kept on T_1 (control) gave the highest net return and economic efficiency whereas the lowest net returns and economic efficiency was obtained from birds kept on T_3 (control+ 2% oyster mushroom) implying that control diet is the best diet from economic point of view [13].

Table 4. Effect of *Pleurotus sp.* mushroom on digestibility of different groups of broilers in summer season

Parameters	Groups				Mean
	G_1	G_2	G_3	G_4	
Dry Matter	59.32	62.21	59.54	59.20	60.06
Crude Protein	63.65	66.16	65.84	65.75	65.35
Crude Fibre	36.86	45.66	45.55	45.55	43.39
Ether Extract	60.05	61.58	61.50	60.45	60.89
Nitrogen Free Extract	79.64	81.25	80.67	80.55	80.52
Mean	59.09	63.37	62.62	62.29	
Factor	**C.D.**		**S.E. (d)**		**S.E. (m)**
Parameters	0.81		0.40		0.28
Groups	0.72		0.36		0.25
Parameters X Groups	1.62		0.81		0.57

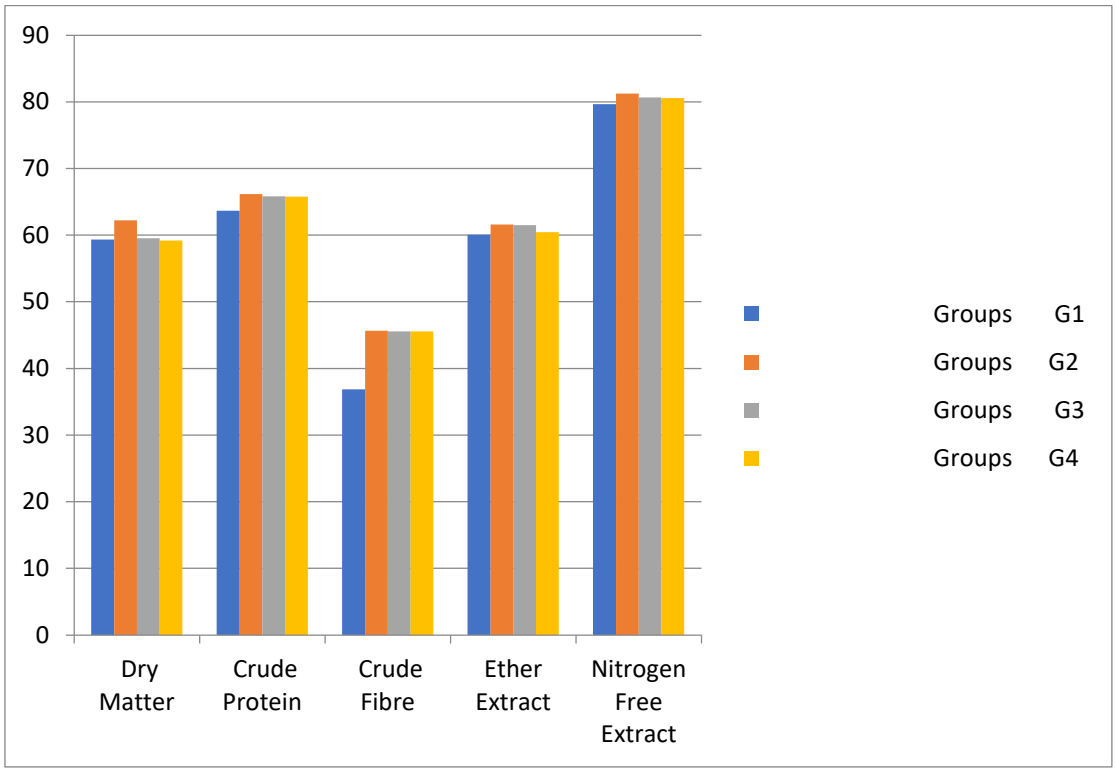

Fig. 2. Nutrient utilization of different groups of broiler chickens

Table 5. Cost and profit analysis in summer season

Particular	G_1	G_2	G_3	G_4
Cost/ Bird	30	30	30	30
Feed cost	61.50	64.10	61.40	62.70
Mushroom	12	12	12	12
Labour cost/ bird	10	10	10	10
Miscellaneous	3	3	3	3
Total cost of production	116.5	119.1	116.4	117.7
Sale/ Bird	130.75	138.56	128.44	130.35
Sale of other	3.50	3.50	3.50	3.50
Net Income	134.25	136.06	131.94	138.85
Net profit/ Bird	17.75	19.46	15.54	12.65

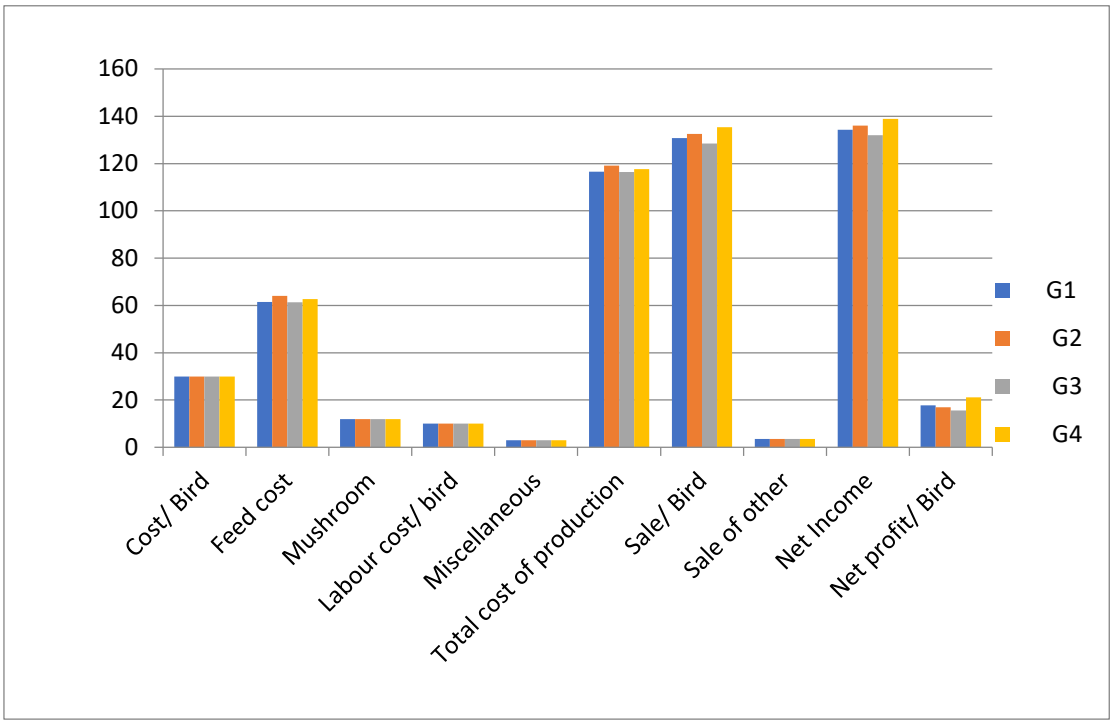

Fig. 3. Economics of different groups of broiler chickens

4. CONCLUSION

From present experiment, it was concluded the application of *Pleurotus sp*.mushroom (*P. florida*, *P.eoes*, *P.sajor* caju respectively) in different groups in the diet of broiler chicks showed highest value in G3 for muscles composition whereas for nutrient utilization and benefit cost ratio recorded maximum for G2 summer season. Therefore, G_2 revealed the *Pleurotous florida* mushroom is necessary for improvement in growth in summer season at the rate of 20 g/kg feed. The inclusion of mushrooms in the diet also reduced this mortality rate and subsequently decreases the production cost which is beneficial to the farmers.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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