International Journal of Advanced Biochemistry Research

ISSN Print: 2617-4693
ISSN Online: 2617-4707
NAAS Rating (2025): 5.29
IJABR 2025; 9(11): 254-259
www.biochemjournal.com
Received: 01-08-2025
Accepted: 05-09-2025

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Effect of early feeding regimen involving synbiotics on feed intake, body weight and return over feed cost of broilers

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DOI: https://www.doi.org/10.33545/26174693.2025.v9.i11d.6232

Abstract
This study aimed to assess the Effect of early feeding regimen involving synbiotics on feed intake, body weight and return over feed cost of broiler chicks. A total of 144 day-old chicks were randomly assigned to four treatment groups, each comprising 9 birds per replicate, with 4 replicates per group. The treatment groups included Control group, birds received synbiotics in water and pre-starter feed upon arrival at the farm for 24 hours. The Negative Control group received water and pre-starter feed without synbiotics. In the Treatment Transport group, birds got synbiotics via beak dip at the hatchery and continued with synbiotics at the farm for 24 hours. In the Treatment On-farm group (OF), birds received pre-starter feed and water with synbiotics immediately after hatching on the farm for 24 hours. The results indicated that OF showed significantly higher (p<0.05) feed consumption and dry matter intake compared to other groups. Body weight and body weight gain was numerically higher in OF group, while FCR was improved (p>0.05) in Treatment Transport compared to other treatments. The Return on Feed Cost (ROFC) in terms of Rs./bird and Rs./kg broiler bird was numerically higher in the Transport group compared to Control, Negative Control and OF.

Keywords: Early feeding, synbiotics, growth performance, economic benefits, return over feed cost (ROFC)

Introduction
Poultry is a major source of meat and one of the industries in the country with the quickest rate of growth. The organization and operations of India's poultry industry have undergone substantial change. In commercial hatcheries, broiler chicks are usually produced in traditional hatchers, which are known as delayed nutrition since they do not get feed and water until they are placed on the farm (Giersberg *et al.*, 2021) [8]. Instead of hatching all at once, eggs do so within a "hatch window," which is the period between the first and final chicks to hatch (Careghi *et al.*, 2005) [5].

This window can vary from 24 to 48 hours until most chicks have hatched and it might be further extended due to other procedures occurring in the hatchery, such as sexing, vaccination, packaging and the distance of Transportation to the farm (Willemsen *et al.*, 2010) [21]. During this waiting period, the hatched chicks rely on residual yolk for sustenance and growth. However, extended periods of holding after hatching and delayed feeding may potentially lead to dehydration and depletion of energy in the chicks, which can negatively impact their growth and overall development (Simon *et al.*, 2015 and Van de Wagt *et al.*, 2020) [16, 20]. The time until the first feed and water intake “holding period” may take up to 72 hr when long Transportation distances are involved. The long Transportation process could exacerbate the depletion of reserves and dehydration through excessive thermoregulatory demands and stress, thus possibly affecting chicks’ BW and mortality rates (De Jong *et al.*, 2012 and Jacobs *et al.*, 2017) [7, 10]. All the problems could largely be resolved by orally delivering appropriate compounds such as essential nutrients, moisture, metabolic modifiers, readily available energy substrates, probiotics and prebiotics immediately after hatch. For this reason, several early feeding systems have recently been developed, including *in ovo* feeding (Uni and Ferket, 2004) [19], on-farm hatching, and hatchery-fed (Da Silva *et al.* 2021) [6] systems.

Combining probiotics and prebiotics to create synbiotics may offer synergistic effects (Basturk *et al.*, 2016) [4]. Thus, a study has been designed to evaluate the effects of early feeding with synbiotics on feed intake, body weight and return over feed cost in broiler chicken.

Materials and Methods

Experimental design

Out of 144 day-old chicks used in research, 108 were obtained from commercial hatcheries and 36 were hatched on the farm. Birds was distributed into four treatment groups (Control, Negative Control, Transport and OF) in four replication and each replication containing nine birds. All chicks were wing-banded, weighed individually and randomly distributed. All these operational procedures were taking about 2 hours. The initial body weight of day old chicks was found to be statistically similar among all the treatments. However, the initial body weight of the day old chicks in treatment OF was significantly higher (p<0.05) compared to other treatments (Table 1). Early feeding and synbiotics supplemented watering might be potentially resulted into prevention of dehydration and depletion of energy in chicks, which could be positively impacted to their body weight.

Treatments and feeding standards

Same experimental feed was formulated to all experimental groups according to the BIS (2007) feeding standard for broiler chickens, categorized into pre-starter (0 to 7 days), starter (8 to 21 days) and finisher (22 to 42 days) phases. These diets were administered based on the day-wise requirements. Synbiotics were supplemented in drinking water (1g/liter) for an initial 24-hour period in the treatment groups. After 24 hours of synbiotics supplemented watering, the feeding and normal watering were followed in all experimental groups.

In the Control group, birds received synbiotics supplemented water and pre-starter feed immediately upon arrival at the farm from the hatchery until completion of 24 hours. The chicks of Negative Control group were giving pre-starter feed and water without synbiotics supplementation upon arrival at the farm from the hatchery. In Treatment Transport, synbiotics were provided by beak dipp method at hatchery and Transported to the farm. Synbiotics supplemented water and pre-starter feed at farm were continued until completion of 24 hours post hatch. In Treatment On-farm, synbiotics supplemented water and pre-starter feed offered as soon as the chicks hatched, which occurred on the farm.

For that, we collect Fifty incubated eggs from the same batch on the 19th day of incubation, ensuring identical conditions for all eggs up to day 18. Thereafter, the eggs were incubated in a Controlled artificial environment under standard incubation conditions that closely replicated the temperature and humidity conditions of a commercial hatcher. Three days prior to hatching, the floor temperature was about 34 °C and air temperature was Controlled (37.5 °C), while the average humidity was around 60-65% from the housing of the embryonated eggs until hatch based on recommendations of Lourens *et al.* (2006) [12] and Molenaar *et al.* (2010) [14]. The temperature and humidity were constantly recorded using dry and wet thermometers. Chicks were started to hatch from 19th day evening to 20th day morning. So, early, access to feed and synbiotics supplemented water was provided to these chicks before 27 to 36 hrs than Control group. Feed and synbiotics supplemented water were provided within the egg tray, giving these birds early access to nutrition compared to other treatment groups. After all, 36 chicks hatched, they were transferred to their pen in broiler house as OF (table 2), where feed and water were offered.

Table 1: Mean body weight (g) of day old experimental broiler chicks under feeding experiment

Replicate	Control	Negative Control	Transport	OF
R_1	46.34	45.39	44.68	55.06
R_2	45.85	46.95	42.72	55.00
R_3	44.60	45.73	44.52	54.04
R_4	45.88	45.73	44.98	51.46
Average	45.67^{b}±0.37	45.95^{b}±0.34	44.23^{b}±0.51	53.89^{a}±0.84
SE	0.73			
CD (0.05)	1.71			

Table 2: Average body weight (g) and feed offered (g) to day old experimental broiler chicks in on farm hatching from day 19th to 21st

Replication	R1	R2	R3	R4	Average
Day 19/20 weight	50.66	50.31	49.94	49.19	50.02
Day 21 weight	55.06	55.00	54.04	51.46	53.89
Weight gain	4.40	4.69	4.10	2.27	3.86
Feed offer	270.00	270.00	270.00	270.00	270
Feed left over	232.50	224.68	237.6	236.6	232.84
Feed consumption	37.50	45.32	32.40	33.40	37.16
F.C/Bird	4.17	5.03	3.6	3.71	4.13
Feed cost (Rs./bird)	0.17	0.20	0.15	0.15	0.17

Performance parameters

The live weight of day-old chicks was recorded at arrival and then on weekly intervals. Each group's average weekly live weight and average weekly weight gain were determined using these data. Feed was provided daily and at the end of each week, the leftover feed was measured to determine weekly feed consumption. The moisture content of the weekly feed sample was analyzed to calculate the dry matter consumption, which was then recorded on a weekly basis. The feed conversion ratio for each group was computed on a weekly and cumulative basis.

Return over feed cost

To determine the cost of feeding per kilogram of live broiler bird, the average feed consumption during the pre-starter, starter, and finisher periods was multiplied by the production cost of each feed type. The total feed cost for each treatment was then divided by the average body weight of the birds to find the cost per kilogram. The return over feed cost (ROFC) was calculated by subtracting the feed cost from the income generated from selling the birds at Rs. 110 per kilogram live weight.

Statistical analysis

The data generated following a Completely Randomized Design was analyzed as per Snedecor and Cochran (2014). Means of replication under each treatment were considered for analysis using software SPSS (version 20).

Results and Discussion

Weekly feed consumption

The total feed consumption per bird during the entire trial period of six weeks were presented in table 3. At the end of

the second week, feed consumption was significantly higher (p<0.05) in Transport and OF group compared to Control and Negative Control group. Likewise, after completion of six-week feed consumption was significantly higher (p<0.05) in OF and Negative Control groups than Control and Transport group. Overall period feed consumption was significantly higher (p<0.05) in OF group compared to other groups. The results of the present inquiry are in agreement with the findings of Abousekken *et al.* (2017) [1] found that birds with Early pre-starter diet (2 day) supplemented group significantly improved (p<0.05) feed consumption than without any supplementation group. In contrast to present study, the result obtained by Arulnathan *et al.* (2019) [3] suggested that feed consumption was significantly increase (p<0.05) in in the basal diet supplemented group relative to the group supplemented with natural growth promoters for two days. Feed consumption of OF group significantly higher (p<0.05) as compared to other treatments. These might be due to early intestinal development and lower dehydration in initial days of life.

Weekly dry matter intake

The total dry matter consumption per bird during the entire trial period of six weeks was presented in table 4. OF group showed significantly higher (p<0.05) dry matter consumption compared to Control, Negative Control and Transport group after end of six-week period.

Table 3: Period wise means of feed intake per bird (g) of experimental broilers under feeding experiment

Period	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Overall	Avg FI
Control	127.36±8.13	290.05^{b}±9.64	512.48±37.68	803.00±28.15	1068.93±59.12	1232.7^{b}±49.64	4034.6^{c}±91.56	96.06^{c}±2.18
Negative Control	139.08±4.95	314.19^{b}±9.53	478.25±11.81	789.14±15.25	1018.57±25.67	1528.3^{a}±27.44	4267.5^{b}±59.78	101.61^{b}±1.42
Transport	133.95±7.33	340.81^{a}±6.07	512.73±18.93	841.28±17.63	1107.52±19.52	1168.3^{b}±43.61	4104.6^{bc}±50.7	97.73^{bc}±1.207
OF	149.57±5.08	348.44^{a}±6.74	561.5±6.98	884.32±15.42	1047.28±21.63	1532.3^{a}±24.84	4523.4^{a}±79.577	107.7^{a}±1.9
SE	3.59	6.98	12.53	13.04	20.41	46.19	58.31	1.39
CD	NS	25.13	NS	NS	NS	116.70	222.54	5.30

Table 4: Period wise means of dry matter intake per bird (g) of experimental broilers under feeding experiment

Period	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Overall	Avg DMI
Control	114.36±7.3	261.28^{b}±8.68	461.64±33.94	724.31^{b}±25.4	964.18±53.33	1111.96^{b}±44.78	3637.74^{b}±82.55	86.61^{b}±1.97
Negative Control	124.89±4.44	237.98^{c}±8.59	430.81±10.64	711.81^{b}±13.75	918.75±23.15	1378.55^{a}±24.75	3802.83^{b}±53.90	90.54^{b}±1.28
Transport	120.28±6.58	307.00^{a}±5.47	461.87±17.05	758.84^{ab}±15.9	998.99±17.61	1053.87^{b}±39.34	3700.85^{b}±45.72	88.12^{b}±1.09
OF	134.31±4.56	313.87^{a}±6.07	505.8±6.29	797.66^{a}±13.91	944.65±44.11	1382.18^{a}±22.4	4078.48^{a}±71.77	97.11^{a}±1.71
SE	3.23	8.79	11.29	11.76	18.41	41.67	52.36	1.25
CD (0.05)	NS	22.64	NS	55.13	NS	105.26	200.66	4.77

Average weekly body weight

The initial and corresponding average live weights at the end of six weeks were presented in table 5. After the end of second week, Transport and OF group showed significantly higher (p<0.05) body weight compared to Control and Negative Control group. Overall period data suggest that numerically higher live body weight in OF group compared to Control, Negative Control and Transport. The present findings are well supported with Mirza and Naji (2011) [13] found no significance difference in body weight between the T_4 group (where the birds were given synbiotics straight upon arrival at the farm) and the Control group (which received a basal diet). Nakphaichit *et al.* (2011) [15] also observed no notable differences in body weight in birds of Control group and the post-hatch probiotic supplemented group. In the same way, Kadam *et al.* (2009) observed that the 6 and 8 gm of the 48-hour polyherbal supplemented group showed equivalent body weights to the 48-hour fasted group. In contrast to our results Arulnathan *et al.* (2019) [3] who suggest that body weight of group supplemented with natural growth promotors was found significantly higher (p<0.05) than Control group. Similar Contrary result was found by Adeleye *et al.* (2018) [11], where significantly higher (p<0.05) final live body weights at 4 hours and 24 hours post-hatch fed compared to those fed at 48 hours post-hatch. Khadem *et al.* (2018) also found significantly (p<0.05) increase in body weight in early feeding after hatch with Vitalite Eenergy Chick at all time points (7, 14, 28 and 39 d).

Average weekly body weight gain

The average weekly gain in weights of birds at the end of six weeks was presented in table 6. As in correspondence to the live weights, the birds in all the treatment groups recorded numerically higher weight gain in OF as compared to the birds in Control group, Negative Control and Transport groups. The data revealed that the differences in the weekly gain in body weights of the birds from different treatment groups were statistically non-significant (p>0.05). Similar findings were reported by Alireza *et al.* (2022) [2], Mirza and Naji (2011) [13], Nakphaichit *et al.* (2011) [15] and Kadam *et al.* (2009). They found non significant difference in body weight gain in early feed supplementation group. Arulnathan *et al.* (2019) [3] found the results contrast to present study, in which the group of birds supplemented with natural growth promoters showing significantly higher (p<0.05) body weight gain compared to the control group bird. Abousekken *et al.* (2017) [1] also found significantly higher (p<0.05) body weight gain in pre-starter offered in hatcher and chick box treatment compared to without feed at hatchery treatment.

Table 5: Period wise means of body weight per bird (g) of experimental broilers under feeding experiment

Period	Day old	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6
Control	45.67^{b}±0.37	127.19±1.79	329.85^{b}±13.73	694.52±53.48	1181.76±55.45	1756.00±80.24	2380.17±84.79
Negative Control	45.95^{b}±0.34	129.81±6.26	310.65^{b}±11.01	665.33±4.89	1180.15$^{\pm}$9.40	1730.88±21.09	2353.83±30.09
Transport	44.23^{b}±0.51	133.37±7.58	366.54^{a}±13.39	700.63±25.73	1226.45$^{\pm}$33.97	1804.91$^{\pm}$32.16	2461.64$^{\pm}$42.7
OF	53.89^{a}±0.84	136.48$^{\pm}$4.41	399.00^{a}±2.71	758.93±23.21	1296.48±26.36	1890.72±54.78	2560.71±83.63
SE	0.98	2.61	10.09	16.77	19.99	28.18	35.78
CD (0.05)	1.71	NS	34.33	NS	NS	NS	NS

Table 6: Period wise means of body weight gain per bird (g) of experimental broilers under feeding experiment

Period	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Overall	Avg daily
Control	81.52±1.81	202.66$^{c\pm}$14.65	364.67±53.50	487.25±21.59	574.24±33.96	624.18±109.89	2334.51±85.07	55.58±2.03
Negative Control	83.86±5.92	180.84$^{c\pm}$6.13	354.68±6.55	514.82±12.56	550.73±12.66	622.95±18.78	2307.88±30.19	45.43±1.01
Transport	89.14$^{\pm}$7.24	233.17$^{b\pm}$8.29	334.09±12.7	525.83±10.53	578.46±6.45	656.73±52.21	2417.41±42.63	44.36±1.28
OF	82.59±5.02	262.52^{a}±4.10	359.93±20.89	537.56±10.42	594.23±36.70	670.00±29.44	2506.82$^{\pm}$84.16	59.69±2.00
SE	2.52	8.97	13.57	8.08	12.30	28.79	35.45	0.84
CD (0.05)	NS	28.31	NS	NS	NS	NS	NS	NS

Average weekly feed conversion ratio

Feed conversion ratio was evaluated on a weekly basis, as demonstrated in table 7. The data derived from these weekly intervals indicated no significant differences in FCR among the various treatment groups. However, a numerical improvement in FCR was observed in the Transport treatment group. These findings are consistent with the results reported by Alireza *et al.* (2022) [2], observing no significant difference in feed efficiency between the early HNG (synbiotics) supplementation group and the control group (p>0.05). Similarly, Mirza and Naji (2011) [13] observed non-significant difference between different ways of synbiotics supplemented groups and non-supplemented groups of broiler chicken. The present findings are in dis-agreement with the findings of Arulnathan *et al.* (2019) [3] found significantly improvement (p<0.05) in natural growth promotors supplemented group than control group with basal diet supplemented group.

Table 7: Period wise means of feed conversion ratio (kg feed/kg gain) of experimental broilers under feeding experiment

Period	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6
Control	1.00±0.07	1.27^{b}±0.03	1.35±0.10	1.47±0.07	1.61±0.09	1.70±0.06
Negative Control	1.07±0.04	1.46^{a}±0.04	1.40±0.03	1.46±0.03	1.58±0.04	1.81±0.03
Transport	1.01±0.02	1.30$^{b\pm}$0.04	1.41±0.02	1.49±0.02	1.63±0.02	1.67$^{\pm}$0.04
OF	1.10±0.01	1.25^{b}±0.01	1.40±0.03	1.50±0.01	1.58±0.02	1.77±0.03
SE	0.02	0.03	0.03	0.02	0.02	0.02
CD (0.05)	NS	0.11	NS	NS	NS	NS

Return over feed cost

Total feed cost observed (Rs./bird) for treatments Control, Negative Control, Transport and OF was 175.33, 185.51, 178.32 and 196.54, respectively. The findings indicate that the cost of feed (Rs./kg broiler bird) and the income from selling birds (110 Rs./kg bird) was higher in OF group compared to other group. However, the Return on Feed Cost (ROFC) in terms of Rs./bird and Rs./kg broiler bird was higher in the Transport treatment group. The cost of early feeding regimens involving synbiotics (Rs./bird) during initial 27-36 hrs of life was just 0.19 for Control and Transport groups, while 0.07 for OF group. which beneficially caused into better ROFC (Rs./bird) compared to without synbiotics supplemented group (Negative Control). Moreover, cost of synbiotics supplementation as beak dipp to broiler chicks before Transportation and continuation of synbiotics for 24 hrs was just 19 paise/bird give rise to improved ROFC either interns of Rs./bird or Rs./kg broiler bird compared to other groups. Total cost of synbiotics supplementation with pre-starter feed for 24 hours for treatment Control, Negative Control, Transport and OF groups was 0.36, 0.20, 0.34 and 0.22, respectively.

Table 8: Return over feed cost (ROFC) of experimental broilers under feeding experiment

		Control	Negative Control	Transport	OF
Feed consumption per bird (g)	Pre-starter	127.36	139.08	133.95	149.57
	Starter	802.54	742.44	853.54	909.94
	Finisher	3104.71	3336.04	3117.18	3463.96
Cost of feed (Rs./kg feed)	Pre-starter	40.50	40.50	40.50	40.50
	Starter	42.60	42.60	42.60	42.60
	Finisher	43.80	43.80	43.80	43.80
Cost of feed consumed (Rs./bird)	Pre-starter	5.16	5.63	5.42	6.06
	Starter	34.19	31.63	36.36	38.76
	Finisher	135.99	146.12	136.53	151.72
Total feed cost (Rs./bird)		175.33	183.38	178.32	196.54
Average body weight (kg)		2.38	2.35	2.46	2.56
Cost of feed (Rs./kg broiler bird)		73.87	77.94	72.51	76.88
Income from selling of birds (110 Rs./kg bird)		261.82	258.89	270.78	281.68
Cost of synbiotics for 24 hrs (Rs./bird)		0.19	0.00	0.19	0.07
Cost of feed for 24 hrs (Rs./bird)		0.17	0.20	0.15	0.15
Total cost of early feeding for 24 hrs (Rs./bird)		0.36	0.20	0.34	0.22
ROFC (Rs./bird)		86.49	75.51	92.46	85.14
ROFC (Rs./kg broiler bird)		36.13	32.06	37.49	33.12

Conclusions

The present study reveals that early feeding and synbiotics supplementation significantly improve the initial body weight and overall growth performance of broiler chicks. The minimal cost of synbiotics supplementation before transportation of chicks from hatchery resulted in a higher return over feed cost (ROFC), making it a cost-effective strategy for enhancing broiler production. These findings suggest that early feeding and synbiotics supplementation can be a practical and economically beneficial solution for the poultry industry, applicable to commercially Transported broilers.

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