RESEARCH PAPER

PRODUCTION PERFORMANCE OF BROILER CHICKENS RAISED ON FEEDS COMPLEMENTED WITH ANTIBIOTIC (AMOXICILLIN) AND CINNAMON AND B-VITAMINS FORTIFIED PROBIOTIC (YOGHURT POWDER) LOADED ON LENTILS, YELLOW CORN, AND WHEAT BRAN

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ABSTRACT

Antibiotics, randomly and rampantly used as growth promoters in global poultry feed industries are a cause of concern to consumer-health due to its propensity to development of antimicrobial resistance, along with other appalling health hazards. Conversely, probiotics are safe alternatives, but inadequately explored, particularly with respect to its fortification with herbs and vitamins. The present study was undertaken to evaluate the effect of antibiotic (Amoxicillin) feed additive compared to natural feed additives comprising probiotic (yoghurt powder), phytobiotic (cinnamon) and B-vitamins loaded with different feed materials, e.g., lentil, yellow corn, and wheat bran in 210 day-old broiler (Ross 308) hatching chicks divided into seven groups, viz., (G1): basal diet (BD), (G2): BD mixed with Amoxicillin, (G3): BD mixed with yoghurt powder (YP) containing cinnamon (*Cinnamomum verum*) and lentil (carrier), (G4): BD mixed with YP containing vitamin B-complex and lentil (carrier), (G5): BD mixed with YP containing vitamin B-complex and yellow corn (carrier), (G6): BD mixed with YP containing cinnamon and yellow corn (carrier), and (G7): BD mixed with YP containing vitamin B complex and wheat bran (carrier) in terms of body weight (g), body weight gain (g), feed consumption (g), feed conversion ratio (g feed/ g gain), production index, and survivability up to five weeks. The results indicated that G5 chicks attained the highest body weight (1896 g), Weekly (1-5 weeks) gain in body weight (1857 g), Feed conversion (1-5 weeks) ratio (1.73), Production index (309.65), and survivability (98.89%), which were significantly ($p \leq 0.05$) higher than the control (G1) as well as the chicks supplemented with antibiotic feed additive (G2). It is concluded that the diet complemented with probiotic YP and B-vitamins delivered through yellow corn (carrier) was the best natural feed additive for production enhancement and better survivability in broiler chicks.

KEY WORDS

Amoxicillin, B-vitamins, Broiler chicks, Cinnamon, Production index, Yoghurt

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INTRODUCTION

Currently, antibiotic growth promoters (AGP), used in the global poultry feed industry is denounced, because of development of antimicrobial resistance, besides harmful side effects (Yeo and Kim, 1997; Tellez et al., 2010). AGPs stimulate the production of deleterious hydroxyl radicals in Gram-negative and Gram-positive microorganisms, which ultimately contribute to cell death (Kohanski et al., 2007). Replacement of AGP with natural growth promoters (NGP) has been found to be effective (Demir et al., 2005) raising a rays of hope for the future. These include phytobiotics (Demir et al., 2005), dairy products (Sultan et al., 2006), and vitamins (Prabhakaran, 2003). NGPs manifest their activities through activation of feed intake through enhanced secretion of digestive enzymes, immune stimulation, and anti-microbial and antioxidant properties (Demir et al., 2005).

Many probiotic additives are in use in poultry industry that improves feed intake and digestibility ensuing better performance in chicks. Yoghurt is a natural probiotic. But probiotic yoghurts are engineered by addition of Lactobacillus and Bifidobacterium species of bacteria, which establish colonies of beneficiary bacteria in the intestine (Kahramanet al., 1996) culminating in improved digestion and feed intake in birds (Aftahi et al., 2006; Mohammed et al., 2015).

Yogurt is a semisolid fermented milk product that originated centuries ago and has evolved from many traditional Eastern European products. Previous studies found that yoghurt can be used effectively as probiotic, as it contains mainly *Lactobacilli* and other beneficial bacteria that have powerful positive health effects (Sultan et al., 2006). Additionally, it is a product of the lactic acid fermentation of milk by addition of starter culture containing *Streptococcus salivarius subsp*. *thermophilus*, *Lactobacillus delbrueckii subsp*., and *bulgaricus* (FAO/WHO, 1977). The benefit of yoghurt depending upon high nutritional and therapeutic properties is being highly consumed and produced (Karagul*et al.*, 2004). Yoghurt could inhibit risk of spoilage from yeasts by storing at 2- 4°C (Tamime et al., 2000), as well as for preventing further activity by starter culture.

Yogurts vary in appearance, flavor and ingredients. The quality of the yoghurt obtained by the processes of milk fermentation is affected by the quality and composition of bacterial cultures in yoghurt (Aftahi et al., 2006). It is supported by the reported symbiotic relationship between *Lactobacillus bulgaricus* and *Streptococcus thermophilus* species culminating in the development of more rapid acidity than in a single strain of culture (Tamime and Deeth, 1980). Various combinations of starter cultures are selected during manufacturing of yoghurt to achieve desirable characteristics to provide the consumers with a wide choice of therapeutic products.

Cinnamon (*Cinnamomum verum*) is a common spice used by different civilizations around the world for several centuries. It is obtained from the inner bark of trees from the genus Cinnamomum. In addition to its culinary uses, in native Ayurvedic medicine, cinnamon is considered as a remedy for respiratory, digestive and gynaecological ailments (Ranasinghe et al., 2013). Cinnamon is a phytobiotic. Its bark contains 1-2% volatile oils, with cinnamaldehyde as the main constituent. It also contains cinnamic acid, coumarin, tannins, cinncassiols, and melatonin (Abascal and Yarnell, 2010). It has antimicrobial and antioxidant properties, and has demonstrated positive effect on growth and feed conversion efficiency by improving digestibility of nutrients (Panda, 2009), when administered in diet in chickens (Shirzadegan, 2014). Furthermore, cinnamon bark has shown potential hypoglycemic action (Abascal and Yarnell, 2010). B-vitamins are also NGP, which promote growth in chicks (Prabhakaran, 2003).

The present study was undertaken to investigate the effect of antibiotic (Amoxicillin) feed additive compared to natural feed additives comprising probiotic (yoghurt powder), phytobiotic (cinnamon) and B-vitamins loaded with different feed materials, e.g., lentil, yellow corn, and wheat bran, to evaluate the production performance of broiler chicken in terms of growth, feed conversion efficiency, production index, and survivability.

MATERIALS AND METHODS

Experimental Design: This experiment was conducted at the Poultry Research Unit of the Animal Production Department, College of Agriculture, University of Basra (Iraq) between 2 January and 8 February 2017. A total of 210 day-old broiler chicks (Ross 308) weighing (40 g/chick) on an average were randomly assigned to seven experimental groups (n=30). Each group contained three replicates (10 birds / replicate).
Supplements: Probiotic yoghurt powder (YP) used in the current study were prepared in Microbiology Laboratory, Animal Production Department of the College of Agriculture, and incorporated into broiler basal diets as in the method previously reported by Naji et al. (2012).The probiotic yogurt was synthesized by mixing 990 g of carrier material (lentil flour / ground yellow corn / wheat bran flour) with 8 g yogurt powder and 2 g (cinnamon powder or B-complex vitamins). Then, 3 g of probiotic yogurt per kg feed was added to the basal diet.

The first group (G1) was fed on basal diet without any supplementation (control). The second group (G2) was fed on basal diet containing antibiotic (Amoxicillin at2g/kg feed). The third group (G3) was fed on basal diet supplemented with probiotic YP at 3g/kg feed containing lentils (*Lens culinaris)* flour and cinnamon (*Cinnamomum verum*) powder. The fourth group (G4) was fed on basal diet supplemented with probiotic YP at 3g/kg feed containing lentils flour and B-vitamins. The fifth group (G5) was fed on basal diet supplemented with probiotic YP at 3g/kg feed containing ground yellow corn and B-vitamins. The sixth group (G6) was fed on basal diet supplemented with probiotic YP at 3g/kg feed containing ground yellow corn and cinnamon powder. The seventh group (G7) was fed on basal diet supplemented with probiotic YP at 3g/kg feed containing wheat bran flour and B-vitamins. Feed and water was provided ad libitum, and 24 h of light was provided daily.

Basal diet (Table-1) was formulated and compounded to meet the nutrient requirements of commercial broilers during the starter stage (1-21 days) and finisher stage (22-35 days) are shown in Table-1.The inclusion rates of amoxicillin, probiotic YP, lentil flour, ground yellow corn, wheat bran, cinnamon, and B-vitamins are shown in Table-2.

Observations: Birds were weighted weekly from the beginning of the experiment until fifth week of age. Feed intake and body weight gain were recorded weekly. Feed conversion ratio (g feed: g gain) was calculated. During the experimental period, mortality was calculated from the records of dead chicks against total number of birds and expressed as percentage. Production Index (PI) was calculated according to the equation of Naji (2006).

Statistical analysis: Analysis of variance was performed on data using Completely Randomized Design (CRD) according to SPSS Software (2012). Means were compared by Duncan's (1955) Multiple Range Test ($p \leq 0.05$).

RESULTS AND DISCUSSION

Production performance: The effects of dietary supplementation on weekly body weights and weekly gains in body weight (Table-3, Figures 1&2), weekly feed consumption and weekly feed conversion ratio (Table-4, Figures 3&4) revealed that the treatment groups, viz., G3, G5, G6, and G7 accrued significantly ($p \leq 0.05$) higher body weight (BW), body weight gain (BWG), and improvement in feed conversion ratio (FCR) without affecting the feed intake ($P \geq 0.05$).

Table-1: Ingredients and nutrient composition of starter and finisher diets.

(Ingredient)%	Starter diet (1-21d)	Finisher diet (1-21d)
yellow corn	42.75	**41.75**
wheat	15.0	**22.0**
Soybean meal (44%)	34.0	**27.0**
Broiler protein concentrate (48%)	5.0	**5.0**
Vegetable oil	0.8	**2.3**
Premix	0.2	**-**
limestone	1.5	**1.7**
Common salt	0.25	**0.25**
Total	100	**100**
Calculated composition		
*ME (Kcal /Kg diet)	3010	**3174**
Crude protein (%)	23.10	**20.14**
Calorie: protein ratio	130.30	**157.60**
Calcium (%)	0.93	**0.99**
Phosphorus available (%)	0.42	**0.51**
Lysine (%)	1.35	**1.17**
Methionine + Cystine (%)	0.89	**0.83**

*ME: Metabolizable energy

Table-2: Inclusion rates of dietary complements of different groups (g/kg).

Gr.	Dietary Component	YP (g)	Cinn. (g)	B-vit.(g)	Carrier (g)	
Starter ration (1-21 days)						
G1	Basal Diet	-	-	-	-	-
G2	Antibiotic (Amoxicillin) 2g/kg	-	-	-	-	-
G3	YP + lentil+cinnamon	8	2	-	Lentil	990
G4	YP+lentil+B-vitamins	8	-	2	Lentil	990
G5	YP+ yellow corn+B-vitamins	8	-	2	Y. corn	990
G6	YP+ yellow corn+cinnamon	8	2	-	Y. corn	990
G7	YP+wheat bran+B-vitamins	8	-	2	W. bran	990
Finisher ration (22-35 days)						
G1	Basal Diet	-	-	-	-	-
G2	Antibiotic (Amoxicillin) 2g/kg	-	-	-	-	-
G3	YP + lentil+cinnamon	8	2	-	Lentil	990
G4	YP+lentil+B-vitamins	8	-	2	Lentil	990
G5	YP+ yellow corn+B-vitamins	8	-	2	Y. corn	990
G6	YP+ yellow corn+cinnamon	8	2	-	Y. corn	990
G7	YP+wheat bran+B-vitamins	8	-	2	W. bran	990

With respect to body weight, body weight gain and feed conversion ratio, our results with YP inclusion basal diet were similar to those of Sultan et al. (2006), who had observed significant improvement in BW and FCR when 5 ml/L yoghurt were given to broiler chickens through drinking water, and also agreed with Seifi et al. (2013), who reported that supplementing 20g /L of yoghurt in broiler diets improved body weight and feed conversion ratio. In this respect Mahmmod et al. (2014) had found increase in BW and BWG of broiler chicks which were fed rations supplemented with yoghurt (1kg/100 kg basal diets) during 22-35 days of age.

The improvement in body weight, weight gain and feed conversion ratio may be due to increased nutrient digestibility (Panda, 2009) or due to microbial enzymatic activity as yoghurt constituents exhibit beneficiary effects on the host by enhancing the proliferation of the indigenous microflora (Aftahi et al. 2006). Mansoub (2011) had reported that the increase in body weight might be related to higher digestibility of proteins of milk (powder) and an excellent amino acids balance profile. Moreover, beneficial changes in gut microflora cause reduction in population of *E. coli* and increasing lactate production with subsequent changes in intestinal pH, resulting in improving the production of digestive enzymes (Leeson and Summers, 2005).

Improvement in BW, BWG, and FCR of birds of both groups (G3 and G5) could be due to the contribution of cinnamon, which has powerful antimicrobial and antioxidant properties (Abascal and Yarnell, 2010; Shirzadegan, 2014). Group 4 chicks, supplemented with YP carried by lentils with B-complex vitamins showed significantly ($p \le 0.05$) lower body weight, weight gain and lower feed conversion efficiency as compared with the third group (G3) which have the same carrier material with cinnamon instead of B-complex vitamins. Zare (2011) reported that yoghurt supplementation with 3% lentil flour enhanced acid production during fermentation, but the microbial population were in the same range as in lentil flour supplemented yoghurt. This is probably due to increase in the total solid contents, especially protein content which resulted in stronger texture and less whey protein separations (Lucey, 2001; Peng et al., 2009).

It has also been reported that bacterial flora of probiotic yoghurt is not influenced by B-vitamins (B_1, B_2 and B_6) in humans, as *lactobacilli* consume vitamins resulting in decreased bioavailability of these vitamins in men (Elmadfa et al., 2001). On the other hand, it has been observed that daily consumption of 200 g of both probiotic yoghurt and conventional yoghurt for 2 weeks can contribute to the total intake of vitamin B_1 and B_2 as reflected by increased levels of plasma thiamine and free riboflavin in healthy women (Fabian et al., 2008). .Behrad et al. (2009) have concluded from their observation that addition of cinnamon did not change yoghurt fermentation, but sustained the growth of *lactobacillus spp*.

Table-3: Body weight and body weight gain in different dietary groups.

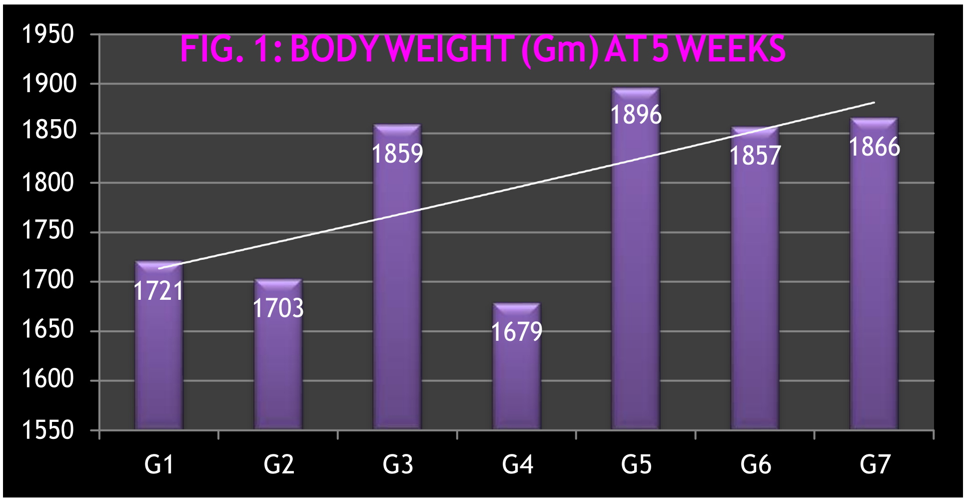
Age (Week)	DIETARY GROUP							SEM
	G1	G2	G3	G4	G5	G6	G7	
Body weight (g)								
1	134	138	137	126	130	129	131	1.51
2	320	327	326	290	298	308	290	8.18
3	624^b	613^b	718^a	633^b	720^a	720^a	763^a	16.12*
4	1214^b	1227^b	1273^a	1175^b	1297^a	1285^a	1285^a	24.42*
5	1721^b	1703^b	1859^a	1679^b	1896^a	1857^a	1866^a	22.59*
Body weight gain (g)								
1	94.46	98.50	97.76	87.13	90.8	90.06	91.63	1.51
2	186	190	189	164	167	179	159	7.51
3	304	286	392	343	423	412	473	14.52
4	590	614	555	542	577	565	523	14.01
5	508^b	476^b	585^a	504^b	599^a	572^a	581^a	24.84*
1-5	1682^b	1664^b	1820^a	1640^b	1857^a	1818^a	1827^a	22.45*

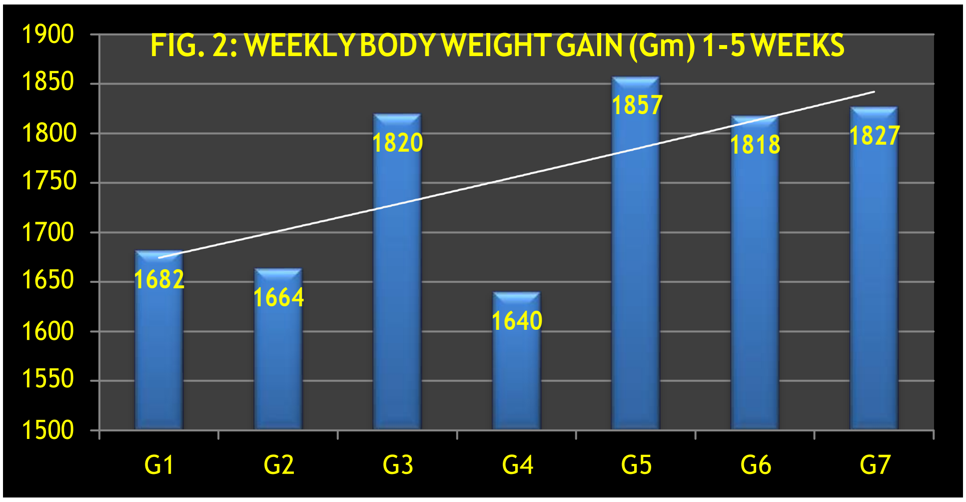
Note: (1) SEM = Standard Error of Means. (2) Means of different dietary groups with uncommon superscripts differed significantly ($p \le 0.05$).

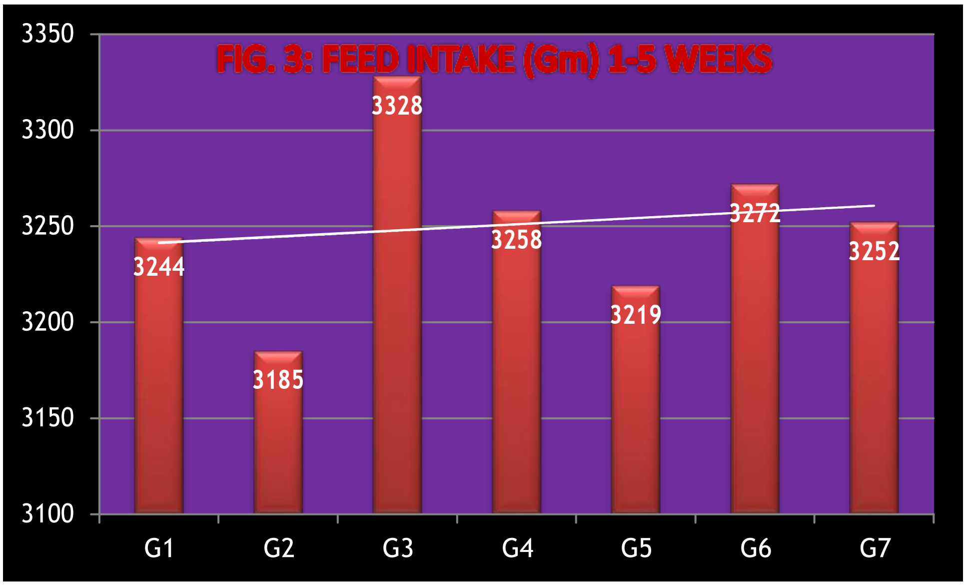
Table-4: Feed intake and feed conversion ratio in different dietary groups.

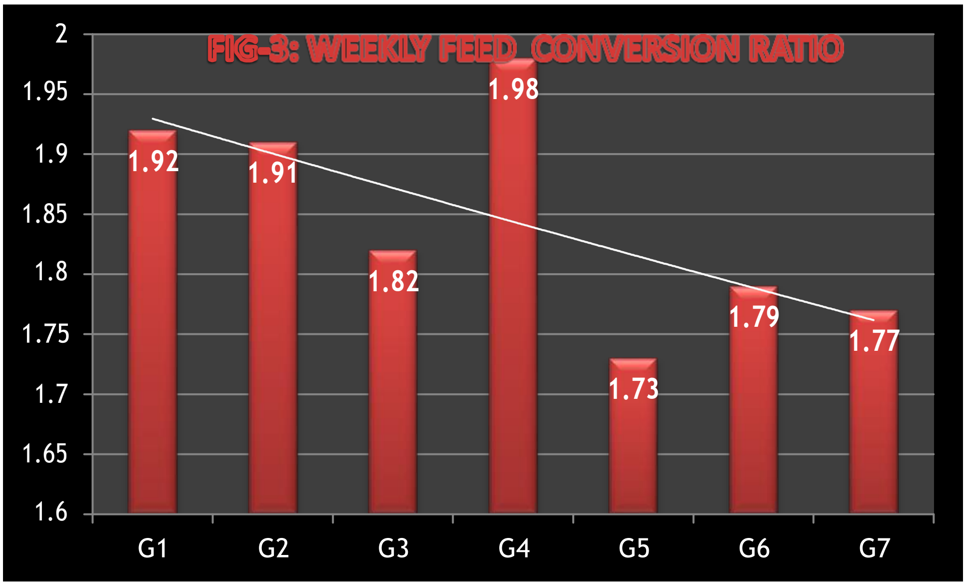
Week	DIETARY GROUP							SEM
	G1	G2	G3	G4	G5	G6	G7	
Feed intake (g)								
1	127	139	152	137	153	154	139	3.85
2	328	383	342	282	221	225	206	19.72
3	565	504	588	562	531	497	576	15.99
4	897	846	840	875	966	981	944	56.37
5	1326	1313	1406	1401	1349	1416	1387	39.58
1-5	3244	3185	3328	3258	3219	3272	3252	104.04
Feed conversion (g:g)								
1	1.34	1.41	1.55	1.57	1.68	1.70	1.51	0.44
2	1.75	2.01	1.80	1.71	1.32	1.25	1.29	0.11
3	1.85	1.75	1.49	1.63	1.25	1.19	1.21	0.07
4	1.52	1.37	1.51	1.61	1.67	1.73	1.80	0.11
5	2.61^{b}	2.75^{b}	2.40^{a}	2.77^{b}	2.25^{a}	2.47^{a}	2.38^{a}	0.11*
1-5	1.92^{b}	1.91^{b}	1.82^{a}	1.98^{b}	1.73^{a}	1.79^{a}	1.77^{a}	0.17*

Note: (1) SEM = Standard Error of Means. (2) Means of different dietary groups with uncommon superscripts differed significantly (p≤0.05).









However, numerous experiments have indicated that supplement of probiotic yoghurt did not have any effect on feed intake (Sultan et al., 2006; Mohammed et al., 2015).

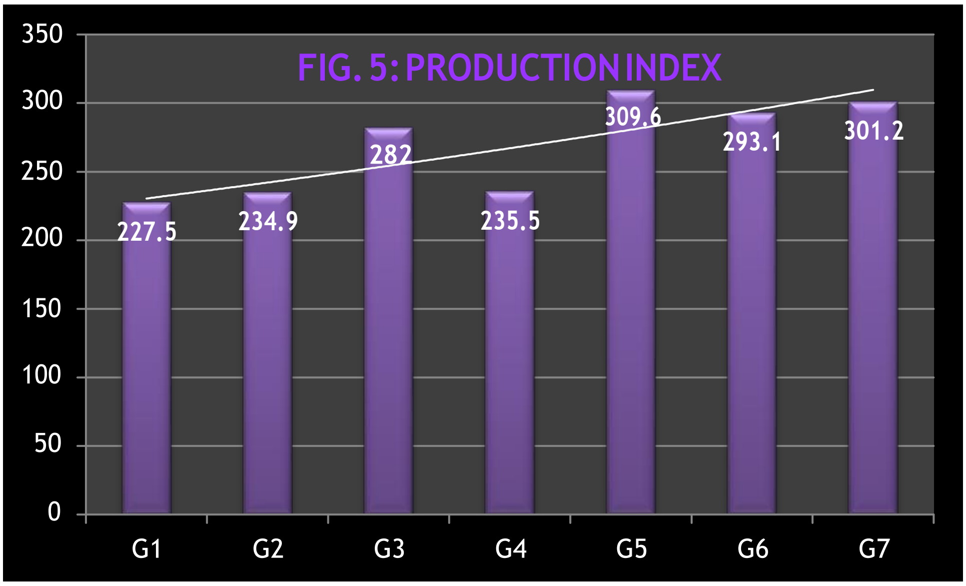
Production Index and Mortality: The production index (Table-5) was the highest (Rank-1) in G5 (309.6), which was significantly ($p \leq 0.05$) higher than G1 (227.5), G2 (234.9), and G4 235.6), but did not differ ($p \geq 0.05$) from G3 (282), G6 (293.1), and G7 (301.2), which could be attributed to better feed conversion ratio and low mortality in natural feed additive supplemented group except G4 (YP+lentil+B-vitamins). Our results agreed with Naji, (2006).

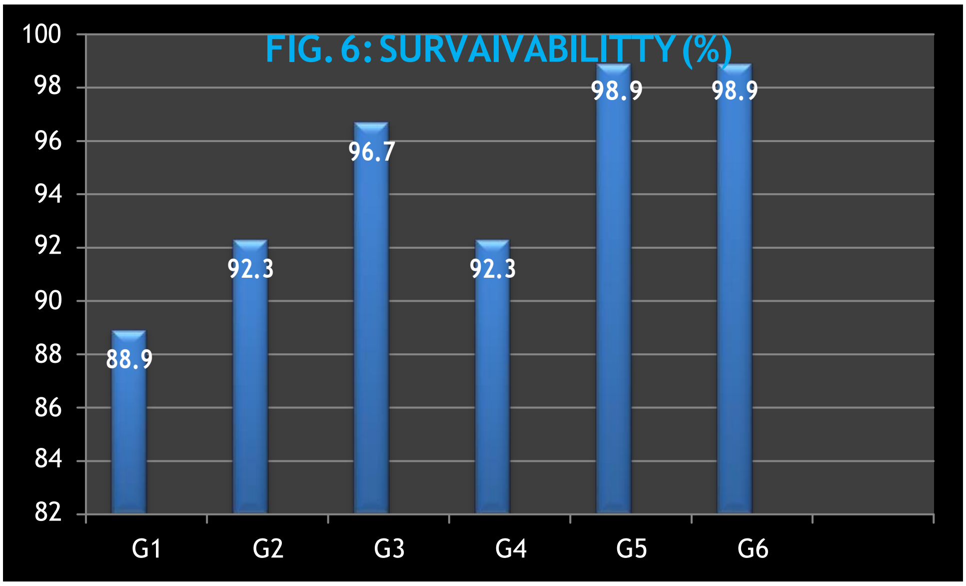
The mortality rate (Table-5) was significantly ($p \leq 0.05$) low in natural additive supplemented groups (G3, G5, and G6) compared to the antibiotic supplemented group (G2) and the control (G1). The reduction in mortality rate in the experimental groups may be due to

Table-5. Production index and mortality in broiler chickens in different dietary groups.

Dietary Group	Production Index	Rank	Mortality (%)
G1	227.56[b]	6	11.11[a]
G2	234.92[b]	5	7.77[b]
G3	282.06[a]	4	3.33[c]
G4	235.6[b]	7	7.77[b]
G5	309.65[a]	1	1.11[d]
G6	293.17[a]	3	1.11[d]
G7	301.26[a]	2	0.00 [e]
SEM	6.96*	*	1.01*

Note: (1) SEM = Standard Error of Means. (2) Means of different dietary groups with uncommon superscripts differed significantly ($p \leq 0.05$).





Improvement in intestinal and mucosal immune functions. Cano et al. (2002) had observed that 5 days of yogurt feeding was the optimal condition for improving gut barrier function and mucosal immune system in a malnutrition model in mice, or may be due to the role of microorganisms in the yogurt powder. Kalavathy et al. (2008) have inferred that dried yoghurt probiotic has great potential for beneficial effect on the gut micro-flora and hence improve gut health in poultry. Their pervious data confirms that adding 1kg of dried yogurt powder to 100 kg of diet is highly efficient in poultry feeding, because they selectively stimulate growth and improve performance, and reduce mortality by inhibiting pathogenic microorganisms such as *E. coli* and *Clostridium spp.* which are sensitive to the earlier culture of beneficial bacteria like *lactobacillus* existing in probiotic as well as dried yogurt powder. These findings are in agreement with the results of Mahmmod et al., (2014) who found significant decrease in total mortalities, when broiler diets were supplemented with dried yogurt powder. Furthermore, peptidoglycan in the cell wall of bacteria such as *lactic acid* bacteria, stimulates macrophage which is needed for activation of T- lymphocytes (Meydani **and Ha, 2000). This** has caused to improve body weight, weight gain, feed conversion and viability percentage.

CONCLUSION

The findings of the current study indicate that supplemented yoghurt powder carriers with lentils, yellow corn, wheat bran with cinnamon or B-complex vitamin has positive effect and could have potential benefit for broiler chicks' performance.

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