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Using of synbiotic and garlic powder as alternatives to antibiotic on growth performance and carcass criteria of Japanese quails

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Abstract

This experiment was designed to evaluate the effects of synbiotic and garlic powder as alternatives to antibiotic on growth performance and carcass criteria of Japanese quails until 42 days of age. In a complete randomized block experimental design, a total number of 156 unsexed one-day-old Japanese quails were allocated randomly distributed into three equal groups; treatment group consisted of four replicates of 13 each. All birds were kept under the same managerial conditions. The first group (C) was fed the basal diet with antibiotic (*Amoxicillin*) 1g/kg diet and served as control, while the second (T1) and the third (T2) groups were fed the basal diets supplemented with synbiotic (PoultryStar® sol) and garlic powder (*Allium sativum*) at the level of 1g and 20g/kg diet, respectively. The results indicated that birds fed diet supplemented with 1g synbiotic/kg diet had significant ($P \leq 0.05$) higher body weight, daily body weight gain, feed consumption and feed conversion ratio as compared with T2 and C groups. Group T1 had no mortalities. Carcass, liver, gizzard and giblets percentages were significantly ($P<0.05$) higher in T1 group compared with other groups, while, the highest value ($P \leq 0.05$) of abdominal fat% was obtained in control one. From these results, it could be concluded that the supplementation of 0.1% synbiotic as an alternative to antibiotic in Japanese quails diets were highly recommended to obtain higher growth performance and carcass criteria.

Keywords: antibiotic, synbiotic, garlic, Japanese quails, performance.

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1. Introduction

production to control disease, and as growth performance promoters to improve growth rate and feed conversion efficiency. However, due to problems of using antibiotics on birds' health and production such as residue in the final products, development of bacterial resistance, accumulation in poultry excretion with consequent environmental pollution (Edens, 2003), its use has been banned in many countries and has been severely limited, or will be eliminated, in many others in the near future via regulations or by initiatives driven by consumer concern. The synbiotic concept is: mixtures of probiotics and prebiotics that beneficially affect the avian by improving the survival and implantation of live microbial dietary supplements in the gastrointestinal tract, by selectively stimulating the growth and/or by activating the metabolism of one or a limited number of health-promoting bacteria, thus improving bird welfare (Gibson and Roberfroid, 1995). The use of synbiotic in poultry production encourages a healthy gut via certain possible mechanisms, such as enhancing the immune system (Hamasalim, 2016), lowering pH, and increasing protective gut mucus (Nikpiran *et al.*, 2013), creating an antimicrobial effect, increasing the digestibility of nutrients and enhancing nutrition performance (Awad *et al.*, 2009). In previous studies conducted on poultry, it was reported that the use of Synbiotic enhances growth performance and carcass yield (Vahdatpour *et al.*, 2011). Gibson and Roberfroid (1995) stated that the use of compounds that may have probiotic effects is a possible way to improve intestinal health and bird performance in the absence of antibiotic growth promoters. *Allium sativum* (garlic) supplements in poultry have been recognized for their strong stimulating effect on the immune system and the very rich aromatic oils enhance digestion of birds (Gardzielewska *et al.*, 2003). The key active ingredient in garlic is a powerful plant chemical called allicin which rapidly decomposes to several volatile organosulphur compounds with bioactivities (Chang and Cheong, 2008). Garlic is used both as condiment and medicament, anticoagulant, antioxidant, hypolipidaemic, antihypertensive, anti-ageing, anti-platelet and heavy metal detoxifier (Agarwal, 1996; Marilym, 2001). The present study aimed to evaluate Japanese quail performance using synbiotic and garlic powder in order to find out the most suitable ones and their possibility as alternatives to antibiotics in quails production.

2. Materials and methods

This study was carried out at Poultry Farm, Department of Poultry Production, Faculty of Agriculture, Assuit University, Assuit, Egypt during the period from March 2018 to May 2018.

2.1 Experimental design

A total number of 156 unsexed, healthy, one-day-old Japanese quails were selected and randomly distributed into three equal groups. Each group included 4 replicates of 13 chicks each. The first group (C) was fed the basal diet with antibiotic (Amoxicillin) 1g/kg diet, while the second and the third groups (T1 and T2, respectively) were fed the basal diet supplemented with synbiotic (PoultryStar® sol) and garlic powder (*Allium sativum*) at the levels of 1g, and 20g/kg diet, respectively. The composition and analysis of the basal diet are shown in Table (1).

2.2 Birds' management

All birds were housed in floor pens at the same space (Dimensions of nest per replicate are Length = 70cm, Width= 35cm, Height= 40 cm), using the straw as litter at 3 cm deepness, in open house under similar hygienic and normal environmental conditions with natural ventilation. All birds were vaccinated for Newcastle disease at 7, 18, and 28 day (B1 Type, LaSota Strain, Live Virus). Vaccine produced by International Company Wiesbaden, Germany (Intervet Company). Feed was available allover experimental period, with the same feeder space. Also, fresh tap water available all time through the normal waterers. The birds during the first week of age were exposed to the continuous lighting program (24 hour light per day), from two week to the end of experiment, the birds were exposed the lighting program of 23 hour light and one hour dark per day; which depend on natural light and exposed to artificial light by using incandescent lambs, 60 watt hanged at a level of 60 cm from the floor.

Table 1: The composition and proximate chemical analysis of the basal diet.

Ingredients	%
Yellow corn	56.5
Corn Gluten (60%)	8.0
Soybean meal (44% CP)	30.0
Limestone	2.1
Di-phosphate calcium	0.6
Salt	0.3
Oil	2.0
Vitamins minerals mixture*	0.3
DL – Methionin	0.1
L-Lysine	0.1
Total	100
Calculated analysis**	
Metabolizable energy kcal/kg diet	3020
Crude protein, %	22.8
Crude fiber, %	3.42
Ether extract, %	4.54
Calcium, %	1.04
Available phosphorus, %	0.45
Methionine and cystine, %	0.9
Lysine %	1.1

*Vitamins and minerals premix provided per kilogram of the diet: Vit A, 1000 IU; D3 2000 ICU; Vit E, 10 mg; Vit K, 1mg; B1, 10 mg; B2, 5 mg; B6, 1500 mg; B12, 10mg Pantothenic acid, 10 mg; Nicotinic acid, 30 mg; Folic acid, 1mg; Biotin, 50 mcg; Chloride, 500 mg; copper, 10 mg; iron, 50 mg; Manganese, 60 mg; Zinc, 50mg, and selenium, 0.1 mg. ** Calculated according to NRC (1994).

2.3 Experiment substances

2.3.1 Antibiotic (Amoxicillin)

The antibiotic which used in this study (Amoxicillin) was provided by the manufacturing company El Nasr Pharmaceutical Chemical Company., Abu Zaabl, Egypt. It's composition as follow: 23g Amoxcillin Trihydrate and 20g Equivalent to Amoxcillin base.

2.3.2 Synbiotic (PoultryStar® sol)

The synbiotic used in this study (PoultryStar® sol) was provided by the manufacturing company BIOMIN Singapore. Supplier by BIOMIN GmbH, Austria. PoultryStar® sol is based on natural raw materials combing the beneficial effects of probiotic and prebiotic. The composition of Synbiotic is/ 900 gm Fructo- Oligosaccharides (Prebiotic), 100 gm Blend of bacteria (Probiotic); Bacteria in blend: *Enterococcus* sp., *Bifidobacterium* sp., *Pediococcus* sp. and *Lactobacilluc* spp.; Product contains a minimum of 5x 10^{12} CFU/ Kg of blend of bacteria.

2.3.3 Garlic powder (Allium sativum)

The garlic (*Allium sativum*) used in this study was bought from a local market in raw form. Then, it was cut into smaller pieces and dried sufficiently in the sunlight. After drying, required amount of garlic was prepared by fine grinding and passing through 1 mm sieve.

2.4 Parameters studied

The live body weight (BW) of each replicate recorded to the nearest gram every week through the experimental period from one day to six weeks of age. Body weight gain was calculated by subtracting initial body weight from final body weight and then divided the result on the number of days to calculate daily body weight gain. Feed consumption of each replicate was recorded as a difference between accumulative weight of feed during the week and the weight of residual feed at the end of the week, and then divided the result on the period to calculate the daily feed consumption as follow: the feed consumption /bird = (Initial weight of feed - final weight of feed) / live birds' number during the period. Daily feed consumption /bird = the feed consumption /the period (days). Feed conversion ratio was calculated as the amount of feed (g) required for producing one gram of body weight gain.

$$\text{FCR} = \frac{\text{Average of feed consumption(g)/bird/day}}{\text{Average of body weight gain (g)/bird/day}}$$

Dead chicks during the experimental period were recorded daily from 7 day of age to the end of experiment. Mortality rate was calculated for the entire experimental period and expressed as percentage.

$$\text{Mortality rate (\%)} = \frac{\text{Number of dead birds of replicate}}{\text{Number of birds of replicate}} \times 100$$

2.5 Slaughter traits

At the end of six weeks of age, six birds (3 males and 3 females) were randomly selected from each treatment, then weighted and slaughtered. After complete bleeding, birds were scaled, and then feather were picked by hand and eviscerated. Different organs (liver, heart, gizzard and giblets) were weighed and expressed as a percentage of carcasses. Also, the abdominal fat was separated, weighed and expressed as a percentage of carcasses.

2.6 Statistical analysis

The data obtained were subjected to statistical analysis using one-way ANOVA according the following model:

$Y_{ij} = \mu + T_i + E_{iK}$

Where; Y_{ij} = an observation; μ = overall mean; T_i = effect of treatment; E_{iK} = random error. Differences among means of the experimental groups were testified for significance by Duncan's multiple range test (Duncan, 1955). Significant differences were considered to exist when $P \leq 0.05$.

3. Results and Discussion

3.1 Growth performance

The effects of alternatives to antibiotic on growth performance (body weight, body weight gain, feed consumption, and feed conversion ratio and mortality rate) are shown in Table (2).

Table (2): The effect of alternatives to antibiotic on growth performance.

Parameters	Age	Groups			SEM	Probability
		C	T1	T2		
Body weight (g)	One day	7.8	7.8	7.8	0.01	0.3664
	1st week	32.6^b	33.7^a	30.8^c	0.04	0.0001
	2nd week	85.3^b	89.9^a	81.6^c	0.32	0.0001
	3rd week	123.6^b	131.6^a	123.8^b	0.45	0.0001
	4th week	172.5^b	185.9^a	172.7^b	0.81	0.0001
	5th week	220.0^b	252.6^a	222.9^b	2.04	0.0001
	6th week	238.7^b	277.9^a	239.7^b	1.23	0.0001
Body weight gain (g/bird/day)	0-3 week	5.7^c	6.3^a	5.9^b	0.21	0.0039
	4-6 week	4.5^b	6.0^a	4.5^b	0.22	0.0002
	0-5 week	6.3^b	7.2^a	6.3^b	0.19	0.0001
	0-6 week	5.2^b	6.5^a	5.2^b	0.15	0.0001
Feed consumption (g/bird/day)	0-3 week	12.7^b	13.1^a	12.7^b	0.61	0.0018
	4-6 week	22.6^c	25.3^a	23.7^b	0.37	0.0003
	0-5 week	16.1^c	17.4^a	16.5^b	0.4	0.0001
	0-6 week	18.5^c	20.4^a	18.4^b	0.28	0.0001
Feed conversion ratio (g feed: g gain)	0-3 week	2.2^a	2.1^b	2.1^b	0.11	0.0041
	4-6 week	5.6^a	4.3^b	5.5^a	0.68	0.0001
	0-5 week	2.6^a	2.4^b	2.6^a	0.09	0.0001
	0-6 week	3.9^a	3.0^c	3.8^b	0.14	0.0001
Mortality rate (%)	0-6 week	0.9^a	0.0^b	0.7^a	0.51	0.0292

^{a,b,c} Means with different superscripts in the same column are significantly different ($P < 0.05$). C= Control (0.1% Amoxicillin), T1= Synbiotic (0.1%), T2= Garlic powder (2%). SEM= Standard error of means.

3.1.1 Body weight (BW)

Data showed that the birds in T1 had significantly ($P \leq 0.05$) higher BW than those of other groups (C and T2) during the whole experimental period (1-42 day of age). Our results revealed that there were no significant differences (P>0.05) between T2 and control at 3rd, 4th, 5th and 6th weeks of age. The obtained results in agreement with the finding of Vahdatpour *et al*. (2011) who showed that the Japanese quails fed 0.1% synbiotic had the higher (P<0.05) BW than those which fed control diet at 1-42 day of age. However, Tofan and Bolacali (2017) reported that the adding of synbiotic at levels 0.1, 0.2, 0.3 and 0.4% had no significant effects (P>0.05) on BW for Japanese quails at 42 day old. While**,** Bonos *et al*. (2010) showed that the addition of prebiotic at 2 g/kg diet for Japanese quails significantly (P<0.05) decreased the BW during the period of 1-42 day of age. The improvement in BW for quails fed diets with 0.1% synbiotic could be attributed to action of probiotic on intestinal microflora and increasing the digestibility, absorbability and utilize ability of different nutrients in gastrointestinal tract by probiotic product enzymes of cellulose, amylase and protease and the action of exogenous enzymes on improving nutrient digestibility and reduction of nitrogen and phosphorus (Bedford, 2000), thus improved BW.

3.1.2 Body weight gain (BWG)

Data of body weight gain (BWG) are presented in Table 2. During 0-3, 4-6, 0-5 and 0- 6 weeks of age, birds fed synbiotic (T1) had significantly higher (P≤0.05) BWG than those fed of Garlic powder diets (T2) or the control diet (C), while there were no significant differences (P≤0.05) between groups (T2 and C). Our findings are in agreement with the findings of Amer and Khan (2011), who stated that supplementation of probiotic to the feed diets at levels 0.5, 1 and 1.5 g/kg diet for broilers, resulted in significantly higher BWG (8-42 days) than those of antibiotic (0.5 g/kg diet zinc bacteracin). However, El-Hammady *et al.* (2014) found that the broilers fed ration supplemented with antibiotic Neomycin (200 mg/kg diet), achieved significantly higher BWG than birds received different levels of probiotic (1, 1.5 and 2 g/kg diet) or the control diet during 0-6 weeks of age. The increase in BWG for quails which fed diets supplemented with 0.1% synbiotic could be considered as probiotics have been used as a feed supplement in diet of poultry to enhance productive performance and immune responses (Higgins *et al.*, 2007). In this regard the dietary supplementation of probiotic benefit the bird by stimulating appetite (Nahashon *et al.*, 1992), stimulate the immune system (Koenen *et al.,* 2004), produce the endogenous digestive enzymes, decrease pH and release bacteriocins (Rolfe, 2000), so improved BWG.

3.1.3 Feed Consumption (FC)

From data presented in Table (2), we can note that birds in T1 had significant (P≤0.05) higher FC as compared to those in other treatments during the whole experimental periods. Also, T2 had significant (P≤0.05) higher FC as compared to control group during 4-6, 0-5 and 0- 6 weeks of age, except during 0-3 weeks of age. The obtained results in agreement with Vahdatpour *et al*. (2011), who showed that FC in birds fed diets with 0.1% synbiotic was significant higher (P≤0.05) than birds which fed control diet for Japanese quails at 1-42 day of age. However, Kalsum *et al*. (2012) stated that there no significant differences (P>0.05) in FC for Japanese quails between treatments of 1g probiotic and antibiotic (1 g/kg diet zinc bacteracin). While, Tofan and Bolacali (2017) indicated that the adding of synbiotic at levels 0.1, 0.2, 0.3 and 0.4% significantly decreased FC as compared to control for Japanese quails at 42day old. The improvement in FC as addition of Synbiotic may be due to the ability of the probiotic and prebiotic to stimulate the appetite of birds. In addition, it may be associated with the improved BWG of the supplemented birds (Nahashon *et al.*, 1996). Hamasalim, (2016) indicated that the improvement in FC may be associated with synbiotic assistance in digestion and absorption.

3.1.4 Feed conversion ratio (FCR)

Data on feed conversion rate are presented in Table (2). During 4-6, 0-5 and 0-6 weeks of age, the birds of group T1 had significantly (P≤0.05) better feed conversion ratio (FCR) than those of the other groups (C and T2). While, there are not significant (P>0.05) between T1 and T2 groups during 0-3 weeks of age. However, during 4-6 and 0-5 weeks of age, there are not significant (P>0.05) between C and T2 groups. During 0-6 weeks of age, birds of T2 had significantly (P≤0.05) better FCR than those of the Group C. These results in agreement with Vahdatpour *et al*. (2011), who indicated that the birds fed synbiotic had the best (P≤0.05) FCR than birds which fed control diet for Japanese quails at 1-42 day of age. Also, Musaad *et al*. (2017) showed that the probiotic at levels of 1, 2, 3 gm/kg diet significantly (P≤0.05) improved FCR as compared with antibiotic (Neomycin) at 5-35 day of age. However, our data disagreement with Manafi *et al*. (2016), who stated that the FCR was significantly (P≤0.0001) improved by adding 0.05% antibiotic (bacitracin methylene disalicylate (BMD)) as compared to 0.1% probiotic (*Bacillus subtilis*) in diets for Japanese quails from 37 to 42 weeks of age. Moreover**,** El-Faham *et al*. (2018) showed that the broilers received colistin antibiotic (Colistix®) 1 g/kg diet had significantly better (P≤0.05) FCR than those of the group birds received probiotic (*Lactobacillus acidophilus* (Bio-Bac-Lac®) at 1g/kg diet during the period of 1-38 day of age. On the other hand, Kalsum *et al*. (2012) stated that there no significant (P>0.05) differences in FCR for laying Japanese quails at 150 day of age between treatments of 1g probiotic/kg (contain *Lactobacilus fermentum* bacteria) diet and antibiotic (50 mg zinc bactericin/kg diet). Khalil *et al*. (2007) fed Japanese quails on garlic powder in diets at level 1.6 % and observed better FCR of birds as compared to control diet during the period of 2-8 weeks of age. In contrast, Yalcin *et al*. (2007) reported that FCR was not affected by adding of garlic powder in diets at levels 5 and 10 g/kg diet for Japanese quails during the period of 9-21 weeks of age. The improvement in FCR for quails received Synbiotic in diets could be attributed to the action of microbial floras on alimentary tract which have considerable effect on health and performance of birds (Alkhalf *et al.*, 2010). The author suggested that the better FCR in synbiotic group could be attributed to the effect of probiotic and prebiotic which improve absorption of nutrients and depressed harmful bacteria that cause growth depression.

3.1.5 Mortality rate (MR)

Data in Table (2) showed group T1 had no mortalities, while there were no significant (P>0.05) differences between T2 and C groups in MR % at (0-6) weeks of age. These results in agreement with Amer and Khan (2011)**,** who indicated that the adding of probiotic at levels 0.5, 1 and 1.5g/kg diet for broilers significantly (P≤0.001) reduced the MR as compared with antibiotic (0.5g zinc bactericin) at 8-42 day of age. In contrast, El-Hammady *et al*. (2014) explained that the MR% for broilers was not differing significantly (P>0.05) among antibiotic (Neomycin) at level 200 mg/kg diet and probiotic at levels 1, 1.5 and 2 g/kg diet during 0-6 weeks of age. Also**,** Musaad *et al*. (2017) showed that the differences in MR were not significant (P>0.05) among treatments of antibiotic (20mg Neomycin /kg diet) and probiotic ***(***(Dexflor- PR) contain Lactobacillus bacteria) at levels of 1, 2, 3 g/kg diet for broilers during the period of 5-35 day of age. No mortalities for Japanese quails resulted by adding of 0.1% Synbiotic may be due to the probiotics had positive effects on health and immune response, also, probiotics had the potential to reduce the risk of infection by pathogens and to eliminate the antibiotic resistance among pathogenic organisms (Griggs and Jacob, 2005), or may be due to the ability of Synbiotic to reduce enteric disease infection, through stimulating of the immune system (Sanders, 1999).

3.2 Caracas criteria

Data of carcass criteria are presented in Table (3). The differences in the percentages of dressed carcass, body organ weights (Gizzard, heart and giblets) were significant (P≤0.05) among all groups. Data revealed that quails in T1 had significant (P≤0.05) higher percentages of carcass, liver, gizzard and giblets as compared to T2 and C groups while, the birds in T2 group had significant (P≤0.05) higher as compared to C group. Data explained that there are not significant in heart percentage among all groups. The abdominal fat percentage in T1 and T2 were lower (P≤0.05) than those of the C group. The abdominal fat percentage in T1 group were lower (P≤0.05) than those of the T2 group. These results are in agreement with those of Chimote *et al*. (2009), who reported that supplementation of probiotic in diets (100g/ton feed) for Japanese quails during the grower period (1-24 day of age) significantly (P≤0.05) increased carcass percentage. As well as, El-Faham (2014), who showed that the percentages of liver, gizzard and giblets were higher (P<0.05) in probiotic treatment at level 1g/kg diet as compared to antibiotic (1 g/kg diet zinc bacteracin) for broilers at 32 day of age. In addition, Musaad *et al*. (2017) found that the differences in percentage heart for broilers were not significantly (P>0.05) among antibiotic (20 mg Neomycin /kg diet) and probiotic ((Dexflor- PR) contain Lactobacillus bacteria) at levels of 1, 2, 3 g/kg diet groups at 5 weeks of age. Also**,** Tofan and Bolacali (2017), who reported that the adding of synbiotic at levels 0.1, 0.2, 0.3 and 0.4% significantly (P≤0.0001) decreased the abdominal fat for Japanese quails at 42 day old. On the other hand**,** Sahin *et al*. (2008) explained that the adding of Synbiotic in diets at levels of 0.5,1 and 1.5 % of Japanese quails had no significant effects on carcass weight during the period of 1-35 day of age. Also**,** Fathi *et al*. (2018) showed that the adding of 1g probiotic /kg diet for broilers at 7-38 day of age had no significant effects on giblets %.

Table (3): The effect of alternatives to antibiotic on carcass, some body organs weights and abdominal fat percentages.

Item	Groups			SEM	Probability
	C	T1	T2		
Live body weight (g)	215.5[b]	242.2[a]	228.0[ab]	1.7	0.0381
Carccass weight (g)	182.7[c]	211.1[a]	195.5[b]	1.8	0.0041
Dressing carcass (including giblets) (%)	84.4[c]	87.2[a]	85.0[b]	0.43	0.0031
Heart (%)	0.8	0.8	0.8	0.11	0.0874
Liver (%)	1.5[c]	2.5[a]	1.8[b]	0.52	0.0001
Gizzard (%)	1.3[c]	1.6[a]	1.4[b]	0.04	0.0438
Giblets (%)	3.7[c]	4.9[a]	4.1[b]	0.02	0.0001
Abdominal fat (%)	1.1[a]	0.7[c]	0.9[b]	0.14	0.0239

[a,b,c] Means with different superscripts in the same column are significantly different (P< 0.05). C= Control (0.1% Amoxicillin), T1= Synbiotic (0.1%), T2= Garlic powder (2%). SEM= Standard error of means.

Concerning the effects of garlic powder, Mahmood *et al*., (2009) found that dietary garlic (0.5%) did not significantly affect heart for broilers. Also, Raeesi *et al*. (2010) revealed that feeding garlic powder-supplemented diets to broilers led to better (P≤0.05) liver, gizzard and giblets percentages as compared to those at control diet without garlic. Our results disagreement with Horton *et al*. (1991), who showed that the adding of garlic powder in diets for broilers had no significant (P>0.05) effect on abdominal fat at 42 day of age. Also, Raya *et al*. (2014) showed that the adding of garlic powder at levels 1,2,3 and 4% the diets for Japanese quails had no significant effect (P>0.01) on carcass, liver, gizzard and giblets percentages at 15-42 day of age. The positive effect of synbiotic on carcass quality may be attributed to the improvement of the bird's health and the more efficient utilization of the feed nutrients, according to Ferket, (2004). Also, it could be due to decreased proliferation of pathogenic bacteria, thus, the digestive tract remains healthy, functions more efficiently and more nutrients are available for absorption (Spring *et al.*, 2000). The improvement in relative weights of liver, gizzard and giblets resulted by alternatives to antibiotic for quails may be due to the greater weight gain and live weight of the probiotic group compared with control group (Awad *et al*., 2009). Also, it may be attributed to the high values of carcass weight for quails received alternatives in their diets as compared to those in control one. The decrease of abdominal fat in alternatives groups (T1 and T2 groups) as compared to antibiotic group could be attributed to that inhibiting the absorption of dietary fat and fatty acid synthesis, and/or promoting fatty acid b-oxidation reduces abdominal fat deposition by decreasing the size and/or the number of abdominal adipose cells. The regulation of lipid metabolism to reduce the abdominal fat content based on dietary composition and feeding strategy, as well as elucidating their effects on the key enzymes associated with lipid metabolism, could facilitate the production of lean meat and help to understand the fat-lowering effects of diet and different feeding strategies (Fouad and El-Senousey 2014). From the obtained results, it can be concluded that the supplementation with of 1g synbiotic/kg diet as an alternative to antibiotics in growing Japanese quails are recommended to obtain higher growth performance, improved feed conversion and lower mortality and abdominal fat.

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