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EFFECT OF SUPPLEMENTING DIFFERENT LEVELS OF JERUSALEM ARTICHOKE (*HELIANTHUS TUBEROSUS* L.) ON BROILER PRODUCTION PERFORMANCE

Abbas A. M. Al-abboodi and Hasan S. A. Jawad*

Department of Animal Production, Faculty of Agriculture, Baghdad University, Iraq

Abstract

A study was undertaken to examine the broiler growth performance effectiveness by daily supplementing Jerusalem artichoke (JA) from 1 to 6 week of age. A total of 390 one-day-old broiler chicks were allocated to 5 treatments, with 3 replicate per treatment and 26 birds per replicate. Experimental treatments including 0% (T1), 0.5% (T2), 1% (T3), 1.5% (T4) and 2% (T5) JA powder were used. Body weight, weight gain, feed intake and feed conversion ratio were recorded weekly. Furthermore, production index (PI), growth rate (GR) and European production efficiency factor (EPEF) were also calculated at the marketing age. The results shows that supplementing 2, 0.5 and 1.5% JA in T5, T2 and T4, respectively, had dependent non-significant ($P>0.05$) in all the production parameters. The improvement percentage for these treatments was about (2.5-4.2%) in final body weight, (5.1-18.5%) in PI, (0.1-0.2%) in GR and (4.7-8.9%) in EPEF. It can be conclude the using 2% of JA caused higher improvement percentage in all the production parameters of broiler chicken.

Key words : Jerusalem artichoke, production performance, inulin, broiler.

Introduction

The Jerusalem artichoke (*Helianthus tuberosus* L.) is an erect, rhizomatous perennial herb, up to 3-4 m hight. Though perennial, it is mainly grown as an annual. It is a highly variable plant: many characteristics, including size (2 to 4 m), tuber color (green or violet), stem number and the number of branches per stem depend on genetics and environmental conditions. The stems are generally hairy and branch in their lower part. The root system is fibrous and develops cord-like rhizomes that can reach more than 1 m in length. The apical part of the rhizome is swollen and forms a fleshy tuber. The leaves are opposite or alternate, ovate to lanceolate, toothed, and pubescent on the lower surface and 3-20 cm long × 5-8 cm broad (Wilkins and Kays, 2008). Phytobiotics is plant products have been used for centuries by humans as food and to treat ailments. Natural medicinal products originating from herbs and spices have also been used as feed additives for farm animals in ancient cultures for the same length of time. To differentiate from the plant products used for veterinary purposes (prophylaxis and therapy of diagnosed health problems), phytobiotics were redefined by Windisch and Kroismayr (2006) as plant-derived products added to the feed in order to improve performance of agricultural livestock. Compared with synthetic antibiotics or inorganic chemicals, these plant-derived products have proven to be natural, less toxic, residue free, and are thought to be ideal feed additives in food animal production (Wang and Bourne, 1998). With respect to biological origin, formulation, chemical description and purity, phytobiotics comprise a very wide range of substances and four subgroups may be classified: 1) herbs (product from flowering, non-woody and non-persistent plants), 2) botanicals (entire or processed parts of a plant, e.g., root, leaves, bark), 3) essential oils (hydro distilled extracts of volatile plant compounds) and 4) oleoresins (extracts based on non-aqueous solvents) (Windisch and Kroismayr, 2006). The dominant prebiotics are fructo-oligosaccharide products (FOS, oligofructose, inulin) (Snel *et al*., 2002; Patterson and Burkholder, 2003); gluco-oligosaccharides, stachyose, malto-oligosaccharides and oligochitosan have also been investigated in broiler chickens (Zhan *et al*., 2003; Gao and Shan, 2004; Jiang *et al*., 2006; Huang *et al*., 2007). Inulin belongs to a class of fructose-based, highly soluble

***Author for correspondence :** E-mail: dr.hassan198366@yahoo.com

polysaccharides collectively called fructans. Fructans are the major non-structural carbohydrates in many plant species, particularly in the prevalent and evolutionarily advanced orders of Asterales, Liliales and Poales *e.g.* chicory, onions, wheat (Hendry, 1993). The current study was aimed to elucidate the effect of Jerusalem artichoke (JA) on broiler production performance. In a previous reports, it was hypothesized that the mechanism resulted in an improvement in the body performance of the chicken fed on diet supplemented by JA (Jawad *et al*., 2017a,b) due to an increase in the level of benefit bacteria in the gastro-intestinal trunk.

Materials and Methods

Chicken husbandry and experimental design

This research was conducted in the poultry farm of Agricultural Faculty in the University of Baghdad from 26th November 2017 to 6th January 2018. This study consists of 390 Day-Old broiler (Ross 308), floor bred. They were randomly assigned to five treatment groups by 78 birds/ treatment and each treatment consisted of three replicates of 26 birds/ replicate. Feed was prepared and offered *ad libitum* the same diets (1–10 days: starter; 11-24 days: grower; 24 day-slaughter: finisher) (table 1) with continuous providing water. Furthermore, constant lighting and continuous ventilation were provided. All the birds were kept under uniform management conditions throughout the experimental period of 6 weeks.

About 60 kg of JA fruit were purchased from market and processed by slicing, drying and grinding. JA powder was supplemented at levels 0.5%, 1%, 1.5% and 2% to the chicken diet of T2, T3, T4 and T5 respectively. Its worthy to mention that chicken in T1 fed on dry food without supplementation.

Sampling procedure and analytic methods

Since week 1 until week 6 of age, weekly body weight (BW) and feed intake (IF) were measured by digital balance (precision = 1 g). Simultaneously, these data were used to calculate the weight gain (WG) and feed conversion ratio (FCR) for the chicken in all the treatments. In the other hand, Growth rate (GR), Production Index (PI) and European Production Efficiency Factor (EPEF) were calculated at the marketing age based on the formulas reported by Brody (1945), Jiang *et al*. (2006), El-Ghany and Madian (2011), respectively. In the same regard, the variation ratio of all the parameters recorded based on the formula mentioned by Jawad *et al*. (2015), Hasan *et al*. (2016), Jawad *et al*. (2016).

Research design and data analysis

This research used one way complete random sampling. The gained data which was resulted were analyzed by one way analysis of variance (ANOVA). If the treatment significantly affected the chicken, LSD and Duncan's (1955) Multiple Range would be applied (DRMT) (Gaspers, 1991; Genstat, 2003). Differences between treatments were considered significant level at $P < 0.05$.

Results and Discussion

The effects of supplementing 0.5; 1; 1.5 and 2g of JA powder in the chicken diet on the live body weight, Growth rate, Production Index and European Production Efficiency Factor are presented in table 2. Overall, no significant different has been reported between the treatments in body weight from week one until the week six of chicken age. Even though, the mean body weight

Table 1 : Composition of basal diet.

Items	Basal Diet		
	1 to 10 d	11 to 24 d	24 to 42 d
Corn	43.8	44.5	47.6
Wheat	14	15.9	15
Soybean meal (44%)	32.7	29	26
Protein concentrated	5	5	5
Sunflower oil	2.2	3.4	4.2
Limestone	1.1	1.1	1.1
Dicalcium phosphate	0.7	0.6	0.6
Salt	0.3	0.3	0.3
Mineral and vitamin premix	0.2	0.2	0.2
Total	100	100	100
100	100	100	Total
Calculated analysis			
Crude protein (%)	22.071	20.7685	19.586
Metabolism energy (kilo calorie per kg. Diet)	2942.7	3051.224	3131.95
Lysine (%)	1.24061	1.15031	1.07416
Methionine (%)	0.50298	0.48624	0.47088
Cysteine (%)	0.35206	0.33384	0.31728
Methionine + Cysteine (%)	0.85504	0.82008	0.60816
Arginine (%)	1.40152	1.29883	1.21128
Calcium (%)	0.28709	0.27745	0.26892
Phosphorus (%)	0.40483	0.3973	0.39078

*calculated analysis according to NRC (1977).

at the marketing age in the second, fourth and fifth treatments were superior (p>0.05) than control group by 75; 65 and 109g, respectively. Arithmetically, best PI value was shown in T5 (18.5%), followed by T4 (6.4%) and T2 (5.1%). Simultaneously, T5 had better EPEF value (8.9%), followed by T2 (4.9%) and T4 (4.7%). Furthermore, GR parameter presents that T2 had best growth (0.2%) compared with the control group and followed by T5 (0.1%).

Supplementation of 0.5, 1, 1.5 and 2g JA in broiler diet impacts on mean weekly weight gain (WG), feed intake (FI) and feed conversion ratio (FCR) are shown in table 3. Predominately, the chicken weight gain in all the treatments did not record significant different (P>0.05) during the experimental period except at week four. Where, chicken in control group had significantly higher weight gain compared with T3 and non-significantly with T2, T4 and T5. Highest total weight gain value was recorded in T5 (4.3%), followed by T2 (3%) and T4 (2.5%) compared with control group. Weekly and total feed intake along the experimental period did not show significantly different between the treatments. Furthermore, same observation was indicated in the weekly and total feed conversion ratio of all the treatments.

Conflicting results shows from the available information that concerns the effect of inulin derived from JA on broiler body or production performance. Biggs *et al*. (2007) reported that supplementing 4 or 8 g/kg inulin in the diet had no significant impact on broiler growth. Also, Rehman *et al*. (2007, 2008) found that 1% inulin did not affect the final body weight of the experimental chickens. Furthermore, inclusion inulin up to 20 g/kg in the dietary feed did not affect the feed intake, body weight gain and feed conversion ratio of broiler (Ortize *et al*., 2009; Alzueta *et al*., 2010). In contrast, Yusrizal and Chen (2003) observed that 10 g/kg inulin improved the body weight gain and feed conversion ratio in female but not in male broiler chicken. Rebole *et al*. (2010) compared using 0, 10, 20 g/kg inulin and reported that 10g/kg caused greater body weight gain. Similarly, Nabizadeh (2012) showed that the body weight gain was increased significantly when 1% inulin supplemented in broiler diet. Current study shows that supplementing 0.5, 1.5 and 2% JA in broiler diet caused depending non-significant (P>0.05) improvement in the final body weight, weight gain, feed intake and feed conversion ratio. Furthermore, analogous observations were shown in the PI, GR and EPEF calculations. In whole, these apparent contradictory responses of chickens to inulin-type fructans might be explained because the effectiveness of inulin or FOS in

Table 2 : Effect of diet supplementation with 0.5, 1, 1.5 and 2g of Jerusalem artichoke on mean weekly body weight, Growth rate (GR), Production Index (PI) and European Production Efficiency Factor (EPEF) of broiler reared for 6 weeks.

Trt.	BW (g)							PI	GR	EPEF
	1 day	1 week	2 week	3 week	4 week	5 week	6 week			
T1	36±0.58	119.27±4.39	312.33±3.76	766±12.22	1344±38.74	1846±11.53	2587.3±104.96	348.19±31.62	194.49±0.18	120.19±11.44
T2	35±0.54	114.6±0.87	317.33±6.69	781±11.72	1335.67±7.22	1890.67±10.65	2663.47±8.41	366.09±20.59	194.81±0.07	126.04±4.95
T3	35.67±0.67	114.93±3.53	310.34±2.67	806.33±34.37	1301±11.85	1907.67±53.7	2540.23±53.35	283.41±19.19	194.46±0.13	113.54±5.17
T4	37±0.58	120.07±2.34	318.31±12.88	792.67±22.84	1351.33±32.69	1871±16.37	2652.67±24.65	370.34±7.8	194.5±0.11	125.9±3.39
T5	36±0.59	116.13±2.13	298.33±13.69	764.67±10.73	1285.67±10.27	1847.67±38.18	2696.53±124.46	412.46±40.07	194.71±0.28	130.85±7.46

* TRT: Treatment; BW: Body weight; PI: Production index; GR: Growth rate; EPEF: European Production Efficiency Factor.

Table 3 : Effect of diet supplementation with 0.5, 1, 1.5 and 2g of Jerusalem artichoke on mean weekly weight gain (WG), feed intake (FI) and feed conversion ratio (FCR) of broiler reared for 6 weeks.

Traits	Trt.	Age						Total
		1 week	2 week	3 week	4 week	5 week	6 week	
WG	T1	83.27±3.85	193.07± 6.09	453.67±11.92	578.00±26.73^{a}	502.00±28.58	741.30±13.27	2551.3±44.62
	T2	79.60±1.22	202.73± 6.57	463.67± 7.31	554.67± 4.84^{ab}	555.00±16.50	772.80±17.07	2628.47±7.98
	T3	79.27±2.91	195.40± 6.11	496.00±33.56	494.67±33.83^{b}	606.67±48.25	632.57±16.29	2504.57±53.21
	T4	83.07±1.91	198.27±13.34	474.33±11.14	558.67±10.37^{ab}	519.67±18.48	781.68±30.52	2615.67±24.79
	T5	80.13±2.03	182.20±11.72	466.33±16.19	521.00± 4.51^{ab}	562.00±28.83	848.87±29.77	2660.53±58.65
FI	T1	109.73±10.82	298.00± 5.69	572.67±26.87	826.33±17.68	997.00± 7.23	1372.47±61.46	4176.2±123.71
	T2	91.13± 4.86	323.00± 5.68	584.33±14.34	845.31±10.35	1034.00±17.35	1343.53±43.30	4221.33±80.62
	T3	120.60±11.48	295.33±12.81	568.68±14.25	836.33± 8.88	1018.00±24.85	1356.13±43.24	4195.07±34.53
	T4	110.53± 9.85	311.32± 8.45	572.33±12.12	837.00±18.36	983.33±33.23	1334.2±59.42	4148.73±112.4
	T5	96.27± 9.59	313.33± 6.77	546.67± 7.20	811.32±20.80	988.667±23.9	1323.47±46.86	4079.73±91.97
FCR	T1	1.31±0.06	1.55±0.09	1.26±0.03	1.43±0.03	2±0.12	1.95±0.14	1.64±0.12
	T2	1.15±0.09	1.6±0.06	1.26±0.03	1.52±0.03	1.87±0.03	1.74±0.07	1.61±0.06
	T3	1.51±0.11	1.51±0.06	1.16±0.09	1.71±0.12	1.7±0.1	2.28±0.2	1.68±0.03
	T4	1.33±0.12	1.58±0.07	1.21±0.01	1.5±0.01	1.9±0.12	1.71±0.06	1.59±0.03
	T5	1.21±0.11	1.73±0.09	1.17±0.03	1.56±0.03	1.763±0.03	1.58±0.12	1.54±0.03

* TRT: Treatment; WG: Weight gain; FI: Feed intake; FCR: Feed conversion ratio. * Mean values with (a, b, c) common superscript in rows differ significantly ($P<0.05$).

broiler feeding depends on many factors. Variables such as concentration, diet type, animal characteristics, hygiene husbandry, and environmental stress can influence the response to inulin or FOS in broiler feeding (Patterson and Burkholder, 2003; Verdonk *et al*., 2005).

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