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EFFICIENCY OF JERUSALEM ARTICHOKE TUBERS POWDER AS FEED ADDITIVES ON JAPANESE QUAIL PERFORMANCE

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ABSTRACT: In this study Jerusalem artichoke tubers powder (JA) as a source of prebiotics at 3% and 6% levels was supplemented in quail chicks' diet to determine the growth performance. An experiment of 42 days was conducted with a flock of 270 unsexed one- day old chicks, were used in a completely randomized design (CRD with 3 treatments and 3 replicates). Treatments were control no additive, T1containing 3% (JA), T2 containing 6% (JA). All chicks had free access to feed and water ad libitum during the 6-wk experiment. Weight gain (WG), feed intake (FI) and feed conversion ratio (FCR) were determined. At the end of experiment three birds per replicate were slaughtered. The results indicated that, chicks fed 3% and 6 % Jerusalem artichoke had higher body weight gain at 42 days and performance index also, lower feed intake; and better feed conversion ratio compared to the control group. Feeding diet containing 6% had the highest total serum protein, Glucose and AST concentrations; moreover were lower than in the control diet. No significant effect of different levels of Jerusalem artichoke on carcass characteristics was detected. Evidently, it may be concluded that the dietary supplementation of Japanese quail chicks with 6% Jerusalem artichoke resulted in considerable improvement in the growth and economic efficiency without adverse effects on carcass characteristics or constituents of blood serum.

Key Words: Jerusalem artichoke, Japanese quail, performance, carcass, blood, efficiency.

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INTRODUCTION

Jerusalem artichoke is a root vegetable. It can serve as a source of fructooligosaccharides which composed of short chains of fructose (Roberfroid,1993) and considered as a prebiotic (Poeikhampha, et al, 2011) which stimulating the growth of good bacteria in the lower gut (Poeikhampha, and Bunchasak, 2011 Gibson, and Roberfroid, 1995) and block the adhesion of pathogenic bacteria in the intestinal mucosa (Mouricout, et al 1990). In addition, prebiotics induce the immune response through a direct effect on cell receptors or via change in the intestinal microorganisms (Buddington, et al, 2002). Several investigators reported that Jerusalem artichoke improved performance, feed utilization and may improve egg production in poultry Yildiz, et al,. 2006 Kaya, et al 2003). The use of prebiotics to improve animal performance and intestinal health is increasing due to the ban on antimicrobial growth promoters in different production systems, such as poultry. This oligofructose is a glucoside present in various vegetal parts (mainly in tubers, leaves or roots), where is stored by accumulation in the cell. The fructan is not digested by the stomach or small intestine enzymes, but the carbohydrate is further fermented to certain extent by the microflora present in the large intestine (Kolida and Gibson, 2007; Park and Park, 2012; Piccolo et al., 2013). Furthermore, inulin similarly to other carbohydrates is a feeding stock for certain lactic acid bacteria, lowering the growth of sensible type of undesired bacteria (Hafany, 2010; Park and Park, 2012).

The present study aimed to investigate the use of Jerusalem artichoke tubers powder in quail nutrition as a natural growth promoting substance. For this purpose, the effects of different inclusion levels of Jerusalem artichoke tubers powder were assessed.

MATERIALS AND METHODS

Two hundred and seventy, unsexed one-day old Japanese quail chicks with an average weight of ±10.6 g were randomly divided into three dietary treatment groups, (90 birds each). Each group was subdivided into three replicates pens of 30 birds each. Birds were reared in pens covered with rice straw litter from 1 day to 42 days of age under similar managerial and hygienic conditions and exposed to 24 hrs constant light. Feed and water were provided ad libitum through the whole experimental period. The chicks were fed on starter diet from 1 to 42 days of age. The experimental diets were formulated to be isocaloric and isonitrogenic according to NRC (1994).The ingredient and chemical composition of the experimental diets are presented in Table (1). The dietary treatments were basal diet as control, T1 basal diet plus 3% JA (30g per kg of diet) and T2 basal diet plus 6% JA (60g per kg of diet). Feed intake (FI) and body weight (BW) of the birds were recorded at weekly intervals. Body weight gain (BWG), feed conversion (FC) and economic efficiency (EE) were calculated. Performance index (PI) was calculated according to North (1984) as follow:

PI= live body weight (kg) x 100/feed conversion.

At the end of 6 weeks of age, 3 birds were randomly taken from each replicate, fasted overnight, weighed and slaughtered to complete bleeding, followed by plucking the feathers. Dressing, giblets (liver, heart and gizzard) were expressed as relative values to live BW. Blood samples were taken at slaughter time from each bird into tubes, and serum was separated by centrifugation at 3500 rpm for 15 min and frozen at - 20^{o} C for the determination of

total protein (TP, g/d), glucose (Glu, mg/dl) creatinine (CR,m/d), AST, ALT, cholesterol (TC) and triglyceride (TG). The proximate analysis of feed was determined according to the methods of A.O.A.C. (2003). The economic efficiency was calculated from the input-output analysis (Heady and Jensen, 1954), assuming that other head costs were constants as follow:
[(price of kg weight gain-feed cost/kg gain)/feed/kg gain x100] under local conditions. The data obtained were statistically analyzed by the completely randomized design using the general linear models (GLM procedure of statistical analysis system (SAS, 1999). The differences among means were determined using Duncan's Multiple Rang test (Duncan, 1955). Percentages were transformed to the corresponding arcsine values before statistical analysis.
The model applied was:
Yij = u+ ai + Eij, where:
Yij = an observation, -u= overall mean.
Ai = effect of treatment (i = 1, 2, 3, 4) and
Eij = experimental random error.

RESULTS AND DISCUSSTION

Growth performance: The effects of dietary treatments on chicks performance are shown in Table (2, 3). Data cleared that Jerusalem artichoke supplementation (T2 and T3) significantly increased
($P< 0.05$) body weight and feed conversion. These results are in agreement with the results of Rebole et al.(2010) who showed that inclusion of inulin in the control diet had a positive effect on the BWG of birds.
Homan et al (2013) noted that feed intake and body weight were significantly increased in broilers feeding 3% chicory root powder during 24 days of study.
In contrast, (Sritiawthai et al. 2013) who reported that performance of laying hens was not influence by adding Jerusalem artichoke 50 and 100 ppm in the diet.
Blood constituents: Results of blood constituents as affected by diet supplemented with different levels of JA are summarized in Table 4. It is clear that the groups fed diet containing JA at level 3% and 6% had the significantly higher Glucose and AST, and lower cholesterol, and triglyceride comparing with the control group. However, here is no significant difference among treatments in total protein or creatinine, these results confirmed those of (Gultekin et al. 2008) who showed that, 6% JA increased glucose ($p<0.001$), SGOT level ($p<0. 01$) and decreased ($p<0. 01$), triglyceride when compared with control diet of laying hens.

Serum triglyceride and total protein concentrations were decreased by 6% JA supplementation as compared with control. On the other hand, cholesterol content tended to decrease.

This may due to inulin play a role in modulation of liver enzymes.

Yusrizal and Chen (2003) reported that adding inulin or oligofructose at the level of 1% reduced ($p<0. 05$) serum cholesterol of broilers. They attributed this reduction to the cholesterol assimilation to the Lactobacilli or to the co-precipitation of cholesterol with deconjugated bile salts (Gilliland et al., 1985). Serum AST levels was increased ($p<0. 01$) by 50g/kg diet of Jerusalem artichoke
Carcass characteristics:
Carcass characteristics relative to the pre-slaughter weight of quail as affected by dietary supplemented with different levels of Jerusalem artichoke are summarized in Table 5. Results showed that there is no significant effect due to inclusion of different levels of Jerusalem artichoke in the experimental diets.
Economic efficiency:
The effect of experimental treatments on the average values of economic efficiency is presented in Table6. According to Jerusalem artichoke levels, the chicks fed

diet containing 6% of JA (T2) recorded the highest values of economic efficiency, followed by chicks which fed diet containing 3% of JA (T1), while the lowest value of economic efficiency was obtained by control group.

It is concluded that addition of Jerusalem artichoke to Japanese quail diets at level of 6% had improving effects on growth performance, blood parameters and economic efficiency.

Table(1): Composition and calculated analysis of the experimental diets fed during (1-42) days of age.

Ingredients	**Starter diets control**
Yellow corn	55
Soybean meal (44%)	35
Gluten meal (60%)	5
Cotton seed oil	2.6
Sodium chloride	0.3
Vit and mineral premix[1]	0.3
Di ca phosphate	1.0
Dl-methionine	0.45
Lysine	0.35
TOTAL	100
Calculated analysis[2]	
Crude protein %	23.07
ME (kcal/kg)	2828.4
Methionine	0.64
Lysine	1.29
phosphours, %	0.30

[1]vitamin and mineral premix. Each 3 kg of vitamin and minerals mixture contain: Vit A 1200 I.U., Vit. D3 2000 I.U., Vit E 40 mg, Vit K 34 mg Vit B1 3 mg, Vit B2 6 mg , Vit B6 4 mg, Vit B12 0.03 mg. Niacin 30 mg. Pantothenic acid 12 mg. Folic acid 1.5 mg. Biotin 0.08 mg. Choline chloride 700 mg. Cu 10 mg. I 300 mg. Fe 40 mg. Mn 80 mg. Co 0.025mg., Zn 70 mg. and Se. 0.02 mg.

[2]Calcaulated according to NRC (1994).

Table(2): Effect of supplemented Jerusalem artichoke on growth performance at 21 days of age.

Item	Dietary treatments			Sig
	control	T1	T2	
Initial body weight,(g)	9.9	9.8	9.8	N.S
Final body weight,(g)	124.5[b]	127.7[a]	130.9[a]	*
Body weight gain,(g)	114.6[b]	117.9[a]	119.1[a]	*
Feed intake,(g/bird)	264.9	264.1	261.9	N.S
Feed conversion,(g feed/g gain)	2.31[a]	2.24[b]	2.19[c]	*
Performance index[1] %	5.38	5.70	5.97	N.S

Means within the same row with different superscripts are significantly different (P≤0.05).

Performance index[1] % = (live body weight, kg x 100)/feed conversion.

Table (3): Effect of supplemented Jerusalem artichoke on growth performance at 42 days of age.

Item	Dietary treatments			Sig
	control	T1	T2	
Initial body weight,(g)	9.9	9.8	9.8	N.S
Final body weight,(g)	219.2[b]	224.7[a]	228.9[a]	*
Body weight gain,(g)	209.3[b]	214.9[a]	219.1[a]	*
Feed intake,(g/bird)	797	795	790	N.S
Feed conversion,(g feed/g gain)	3.80	3.69	3.60	N.S
Performance index[1] %	5.76	6.08	6.35	N.S

Means within the same row with different superscripts are significantly different (P≤0.05).

Performance index[1] % = (live body weight, kg x 100)/feed conversion.

Table (4): Effect of supplemented Jerusalem artichoke on some blood serum constituents.

Items	Dietary treatments			Sig
	control	T1	T2	
Total protein (g/dl)	5.1	4.9	4.2	N.S
Creatinine (mg/dl)	0.6	0.6	0.7	N.S
Glucose (mg/ dl)	239[b]	240[b]	245[a]	*
AST (u/l)	21[b]	22[b]	26[a]	*
ALT (u/l)	7	9	7	NS
Cholesterol (mg/dl)	130	125	121	*
Triglyceride (mg/dl)	45	42	41	NS

Means within the same row with different superscripts are significantly different (P≤0.05).

Table(5): Effect of supplemented Jerusalem artichoke on carcass and organ's percentage of Japanese quail

Items	Dietary treatments			Sig
	control	T1	T2	
Pre-slaughter weight (g)	201	203	211	N.S
Dressing weight (g)	171	184	189	N.S
Dressing (%)	85.1	90.6	89.5	N.S
Liver (%)	2.5	3.0	2.3	N.S
Heart (%)	0.50	0.44	0.46	N.S
Gizzard (%)	2.3	2.2	2.4	N.S

Means within the same row with different superscripts are significantly different ($P \leq 0.05$).

Table(6): The economic efficiency of the experimental diets.

Item	control	T1	T2
Initial body weight, g	9.9	9.8	9.8
Final body weight, g	219.2	224.7	228.3
Body weight gain, g	209.1	214.9	218.5
Revenue from gain, L.E/ bird	6.27	6.44	6.55
Feed intake, kg	797	795	790
Price of kg feed, L.E	3.50	3.56	3.62
Feed cost, L.E	2.78	2.81	2.85
[1]Net revenue. L.E	3.49	3.63	3.70
[2]Economic efficiency, (%)	1.26	1.29	1.30
Relative economic efficiency, (%)	100	102.3	103.2

[1]Net revenue= revenue from gain – feed cost.
[2]Economic efficiency = (net revenue / feed cost)*100.
Price of Kg live body weight was 30 L.E.
Price of one kg Jerusalem artichoke was 2 L.E.

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الملخص العربى

تأثير اضافة مستويات مختلفة من مسحوق درنات الطرطوفة على أداء السمان اليابانى

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أجريت هذه الدراسة باستخدام ٢٧٠ كتكوت سمان عمر يوم وذلك لدراسة تأثيراضافة مستويات مختلفة من مسحوق درنات الطرطوفة على الأداء الانتاجى وخصائص الذبيحة وصفات الدم وأيضا الكفاءة الاقتصادية. تم تقسيم الكتاكيت بشكل عشوائى الى ٣ مجاميع حيث اشتملت كل مجموعة على ٩٠ طائر موزعة على ٣ مكرارات بكل مكرر ٣٠ كتكوت. تم اضافة ٣ مستويات من مسحوق جذور الطرطوفة وهى صفر، ٣، ٦ % .

أوضحت النتائج أنه يوجد فروق معنوية لكل من وزن الجسم والزيادة فى وزن الجسم كما لوحظ تحسن فى العلائق المضاف اليها ٣، ٦%من مسحوق درنات؛ الطرطوفة . لوحظ ايضا أن المستوى ٦% افضل فى صفات الدم وكذلك الكفاءة الاقتصادية.

ومن ذلك نستنتج ان العلائق المضاف اليها ٦% من مسحوق درنات الطرطوفة أدى الى تحسن فى الأداء الانتاجى وبالتالى الكفاءة الاقتصادية بدون أثر سلبي على خصائص الذبيحة ومكونات الدم.