



## **EFFECT OF NATURAL FEED ADDITIVES ON GROWTH PERFORMANCE AND CARCASS CHARACTERISTICS OF GROWING RABBITS**

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### **ABSTRACT**

Thirty-two males and Thirty-two female New Zealand White rabbits at the age of 8 weeks were randomly divided into four treatment groups. Each treatment group was divided into eight replicate. The 1<sup>st</sup> group was received basal diet .While rabbits in the 2<sup>nd</sup>, 3<sup>rd</sup> and 4<sup>th</sup> groups were received basal diet supplemented with 0.1% ginger, 0.5% curcuma and the mixture of ( 0.1 % ginger + 0.5% curcuma)., respectively. Experimental diets and tap water were offered *ad-libitum* all over the experimental period.

Results obtained showed that using 0.1% ginger and 0.5% curcuma in rabbit diets increased body weight, cumulative body weight gain and improved cumulative feed conversion at most age intervals studied. Cumulative feed consumption of rabbits fed diets containing 0.1% ginger and 0.5% curcuma were insignificantly ( $p>0.05$ ) lower than those of the control group. Body weight, cumulative body weight gain and cumulative feed consumption of male rabbits were significantly improved ( $p < 0.05$ ) than those of females, while the cumulative feed conversion were not significantly ( $p >0.05$ ) affected by sex of animal. Carcass parameters of rabbits were not affected ( $p > 0.05$ ) by ginger and curcuma supplementation. Ginger and curcuma supplementation in rabbit diets increased the relative economical efficiency as compared to the control group.

**Keyword** (natural feed additives, growth performance, rabbits)

## INTRODUCTION

Rabbit production is a veritable way of alleviating animal protein deficiency in Egypt. Growth promoters are commonly added to the animals feed for growth enhancement and efficient feed utilization. Natural products of plant origin like spices, herbs and many plant extract can be considered as alternative to antibiotics as growth promoters in improving animal performance (Hernandez *et al.*, 2004). Feed additives are added in animal feed to improve their nutritive value, boost animal performance by increasing their growth rate, better feed conversion efficiency, greater livability and lowered mortality in poultry (Devegowda 1996).

Ginger (*Zingiber officinale*) is one of the most commonly consumed dietary condiments in the world (Surh *et al.*, 1999). Ginger has antibacterial and anti-inflammatory actions, and ginger rhizome is known to lower blood cholesterol level in man (Herbs Hands Healing 2011). Also, important compounds in ginger has the ability to stimulate the digestive enzymes, the impact on microbial activity (Dieumou *et al.*, 2009).

Curcuma spp. contains turmeric essential oils and curcuminoids including Curcumin and the curcuminoids can be defined as phenolic compounds derived from the roots of Curcuma spp. (Sharma *et al.*, 2005). Turmeric have antioxidant, antibacterial, antifungal and antiviral activities (Chattopadhyay (2004).

Turmeric extract seemed to be able to improve the digestion and metabolism (of fat) resulted in enhanced production of hemoglobin in broilers Sugiharto *et al.*, (2011).

Using natural feed additives in rabbit diets increased body weight, body weight gain, decreased feed consumption and improved feed conversion of rabbits (Ibrahim *et al.*, (2011) using ginger and Foldesiova *et al.*, (2015) using curcuma longa. The aim of this study to evaluate the effects of adding Turmeric (*Curcuma longa*) and ginger (*Zingiber officinale*) as natural feed additives to growing rabbit diets on growth performance and carcass characteristics.

## MATERIALS AND METHODS

Thirty-two males and Thirty-two females New Zealand White rabbits at the age of 8 weeks were randomly divided into four treatment groups (8 males and 8 females) each. Each treatment group were divided into eight replicates. The rabbits in the 1<sup>st</sup> group were received the basal diet (control) containing 17 % protein and 2507 Kcal. M.E/ Kg diet according recommended by the National Research Council, (NRC, 1994), while those in the 2<sup>nd</sup>, 3<sup>rd</sup> and 4<sup>th</sup> groups were received basal diet supplemented with 0.1% ginger, 0.5% curcuma and the mixture of 0.1 % ginger + 0.5% curcuma., respectively. Feed ingredients and calculated chemical analysis of the basal diet are shown in Table (1). Experimental diets and tap

water were offered *ad-libitum* all over the experimental period.

Live body weights (gm), feed consumption (gm) were recorded by biweekly from 8 up to 16 weeks of age. Cumulative body weight gain, feed consumption and feed conversion ratio were calculated at 8-10, 10-12, 12-14 and 14-16 weeks of age. At the end of the experimental period (at 16 weeks of age), six male rabbits from each treatment were slaughtered after 12 hours fasting. The carcasses obtained were weighed and the dressing out percentage was calculated as carcass weight  $\times$  100/ slaughter weight. Abdominal fat and Giblets including liver, heart and kidneys were removed, weighed and expressed as percentage with respect to carcass weight. The Economic Efficiency of dietary treatments were estimated according to the prices of 2015 in Egyptian pound (LE). Economic evaluation for all experimental diets was calculated as follows:

Economical efficiency = Net revenue/ Feed cost and relative economical efficiency = Economical efficiency/Economical efficiency of control

Statistical analysis were analyzed using the GLM procedure of Statistical Analysis System (SAS, 2008).

Significant differences among treatments were separated by Duncan's multiple range test Duncan (1955).

Growth traits were statistically analyzed by using the following model:

$Y_{ijk} = \mu + T_i + S_j + (TS)_{ij} + E_{ijk}$  While carcass traits were statistically analyzed by using the following model:

$Y_{ij} = \mu + T_i + E_{ij}$  where,

$Y_{ijk}$  = an observation.  $\mu$  = The overall mean.

$T_i$  = effect of dietary treatment (1,2,3,4).  $S_j$  = effect of sex, male, female,

$(TS)_{ij}$  = effect of interaction between treatment and sex,

$E_{ijk}$  = The experimental error.

Table (1): Feed ingredients and calculated chemical analysis of basal diet

Ingredients	%
Ground yellow corn	50.00
Soya bean meal (44%)	20.50
Wheat bran	11.16
Alfalfa hay	12.00
Beet pulp	3.00
Lime stone	1.00
Calcium phosphate bilateral	2.00
Methionine trade	0.04
Salt	0.30
Total	100
Calculated chemical analysis	
Protein	17
ME (kcal/ kg)	2507
Fat	2.74
Fiber	7.48
Calcium	1.10
Phosphorus	0.79
Sodium	015
Lysine	0.85
<i>Methionine + cysteine</i>	0.60

\*Each 0.5 kg of vitamins and minerals mixture contains: 12000.000 IU vitamin A acetate; 2000.000 IU vitamin D3; 10.000 mg vitamin E

acetate; 2000 mg vitamin K3; 100 mg vitamin B1; 4000 mg vitamin B2; 1500 mg vitamin B6; 10 mg vitamin B12; 10.000 mg pantothenic acid; 20.000 mg Nicotinic acid; 1000 mg Folic acid; 50 mg Biotin; 500.000 mg choline; 10.000 mg Copper; 1000 mg Iodine; 300.00 mg Iron; 55.000 mg Manganese; 55.000 mg Zinc, and 100 mg Selenium.

## RESULTS AND DISCUSSION

### Growth performance:

#### 1. Body weight (gm):

Results presented in Table (2) indicated that the effect of natural feed additives on body weight of New Zealand White rabbits was not significant ( $p > 0.05$ ) at all ages studied. Results obtained by Omage *et al.*, (2007) using ginger waste meal, Quiles *et al.*, (2002) using curcuma, Basavaraj *et al.*, (2011b) using turmeric rhizome powder, Peiretti *et al.*, (2011) using curcuma longa, and Alagawany *et al.*, (2015b) on turmeric concluded that the effect of natural feed additives on body weight of rabbits was not significant ( $p > 0.05$ ). These results may be due to that the ingredients of the four diets are concerned, they only differed according to the presence or lack of natural feed additives and the chemical composition and gross energy of the diets were therefore similar. However, the heaviest final body weight at 16 weeks of age was significantly ( $p < 0.05$ ) recorded for rabbits fed diet containing both 0.1% ginger and 0.5% *curcuma*, while the lightest one was

observed for rabbits fed diet containing 0.1% ginger only.

Average body weight of male New Zealand White rabbits was heavier ( $p < 0.05$ ) than that of females at all ages studied. Results obtained by Toson *et al.*, (1999), Uouhana (2005) and Fayeye and Ayorinde (2008) concluded that male rabbits was significantly heavier than that of females. Data presented in Table (2) showed that the interaction between natural feed additives and sex of rabbit on body weight was not significant ( $p > 0.05$ ) except at 8 weeks of age which was significant ( $p < 0.05$ ).

#### 2. Cumulative body weight gain (gm):

Results presented in Table (3) showed that cumulative body weight gain of rabbits fed on diet containing both 0.1 % ginger and 0.5% curcuma at 8-14 and 8-16 weeks of age intervals was higher ( $p < 0.05$ ) than those of the control group. The previous studies concluded that feeding rabbits of natural feed additives diets improved total weight gain, Ibrahim *et al.*, (2011) using ginger and Foldesiova *et al.*, (2015) using both concentrations (5 g and 20 g /kg diet) of *Curcuma longa* dried powder. Tekeli *et al.*, (2011) attributed the improvement in body weight gain of broiler chicks fed on ginger to the active components present in the ginger which stimulates digestive enzymes and improves overall digestion and thus leads to increased body weight gain. Al-Sultan (2003) attributed the increase in the body weight gain of broilers fed diets

containing curcuma to the antioxidant activity of *Curcuma longa*. Moreover, Longhout (2000) demonstrated that the positive results of ginger and turmeric supplemented diets could be related to the fact that the aromatic herbs have

some growth promoting and anti-heat stress properties for growing birds and possibly they may have stimulating effects on the animal digestive system.

Table (2) Body weight of rabbits at the different ages as affected by natural feed additive and sex:

Classification	Body weight (gm) $\pm$ SE at				
	8 weeks	10 weeks	12 weeks	14 weeks	16 weeks
Feed additives:	NS	NS	NS	NS	NS
Control	1116.25	1398.75	1687.50	1952.50 <sup>ab</sup>	2235.00 <sup>ab</sup>
0.1 % Ginger	1106.25	1383.13	1669.38	1923.75 <sup>b</sup>	2219.38 <sup>b</sup>
0.5 % Curcuma	1104.38	1398.13	1699.38	1986.88 <sup>ab</sup>	2280.00 <sup>ab</sup>
Ginger + Curcuma	1093.75	1391.25	1691.25	2010.00 <sup>a</sup>	2306.88 <sup>a</sup>
SE	13.67	15.82	20.19	24.34	24.62
Sex:	**	**	**	**	**
Male	1139.69 <sup>a</sup>	1441.88 <sup>a</sup>	1748.13 <sup>a</sup>	2035.94 <sup>a</sup>	2323.44 <sup>a</sup>
Female	1070.63 <sup>b</sup>	1343.75 <sup>b</sup>	1625.63 <sup>b</sup>	1900.63 <sup>b</sup>	2197.19 <sup>b</sup>
SE	9.67	11.19	14.27	17.21	17.41
<i>Feed additives</i> $\times$ <i>Sex</i> :	*	NS	NS	NS	NS
<i>Control</i> $\times$ <i>M</i>	1185.00	1485.00	1770.00	2032.50	2282.50
<i>Control</i> $\times$ <i>F</i>	1047.50	1312.50	1605.00	1872.50	2187.50
<i>0.1 % Ginger</i> $\times$ <i>M</i>	1121.25	1408.75	1712.50	1967.50	2273.75
<i>0.1 % Ginger</i> $\times$ <i>F</i>	1091.25	1357.50	1626.25	1880.00	2165.00
<i>0.5 % Curcuma</i> $\times$ <i>M</i>	1121.25	1432.50	1745.00	2028.75	2313.75
<i>0.5 % Curcuma</i> $\times$ <i>F</i>	1087.50	1363.75	1653.75	1945.00	2246.25
<i>Ginger + Curcuma</i> $\times$ <i>M</i>	1131.25	1441.25	1765.00	2115.00	2423.75
<i>Ginger + Curcuma</i> $\times$ <i>F</i>	1056.25	1341.25	1617.50	1905.00	2190.00
SE	19.34	22.37	28.55	34.42	34.82

NS not significant, \* significant at 5% level, \*\* significant at 1% level Means within the same classification had similar litter(s) are not significantly different ( $P < 0.05$ )

The cumulative body weight gains of male rabbits were significantly higher than those of females (Table,3). Similar results were obtained by Toson *et al.*, (1999) and Uouhana (2005) on New Zealand White rabbits.

Results presented in Table (3) revealed that the effect of interaction

between natural feed additives and sex on cumulative body weight gain was significant only at the whole period 8-16 weeks of age.

### 3. Cumulative feed consumption (gm):

Cumulative feed consumption of rabbits fed on diets containing 0.1% ginger, 0.5% curcuma and both 0.1%

ginger with 0.5% curcuma was significantly lower as compared to the control group (Table 4). Ibrahim et al (2011) concluded that using ginger as feed additives in rabbit diets decreased feed consumption of rabbits. The same authors attributed the decrease of feed intake of rabbits by using ginger

additive due to the feeling of satiety or fullness.

Cumulative feed consumption at 8-12, 8-14 and 8-16 weeks of male rabbits were significantly higher than those of females. Similar results were obtained by Toson *et al* (1999).

Table (3): Cumulative body weight gain of rabbit at the different ages as affected by natural feed additive and sex:

Classification	Cumulative body weight gain (g) ± SE at			
	8-10 weeks	8-12 weeks	8-14 weeks	8-16 weeks
Feed additives:	NS	NS	*	*
Control	282.50	571.25	836.25 <sup>b</sup>	1118.75 <sup>b</sup>
0.1 % Ginger	276.88	563.13	817.50 <sup>b</sup>	1113.13 <sup>b</sup>
0.5 % Curcuma	293.75	595.00	882.50 <sup>ab</sup>	1175.63 <sup>ab</sup>
Ginger + Curcuma	297.50	597.50	916.25 <sup>a</sup>	1213.13 <sup>a</sup>
SE	11.05	17.72	23.20	23.03
Sex:	*	**	**	*
Male	302.19 <sup>a</sup>	608.44 <sup>a</sup>	896.25 <sup>a</sup>	1183.75 <sup>a</sup>
Female	273.13 <sup>b</sup>	555.00 <sup>b</sup>	830.00 <sup>b</sup>	1126.56 <sup>b</sup>
SE	7.81	12.53	16.41	16.28
Feed additives × Sex:	NS	NS	NS	*
Control × M	300.00	585.00	847.50	1097.50
Control × F	265.00	557.50	825.00	1140.00
0.1 % Ginger × M	287.50	591.25	846.25	1152.50
0.1 % Ginger × F	266.25	535.00	788.75	1073.75
0.5 % Curcuma × M	311.25	623.75	907.50	1192.50
0.5 % Curcuma × F	276.25	566.25	857.50	1158.75
Ginger + Curcuma × M	310.00	633.75	983.75	1292.50
Ginger + Curcuma × F	285.00	561.25	848.75	1133.75
SE	15.62	25.06	32.82	32.57

NS not significant, \* significant at 5% level, \*\* significant at 1% level Means within the same classification had similar litter(s) are not significantly different (P<0.05)

As presented in Table (4), the effect of the interaction between natural feed additives and sex of rabbit on cumulative feed consumption was significant only during the whole period from 8 up to 16 weeks of age.

These data indicated that the highest cumulative feed consumption was recorded for female rabbits fed the control diet, while the lowest one was recorded for female rabbits fed diet

containing both 0.1% ginger and 0.5% curcuma.

**4. Cumulative feed conversion:**

Data presented in Table (5) showed that the cumulative feed conversion of rabbits fed diets containing 0.1% ginger, 0.5% curcuma and the mixture of 0.1% ginger and 0.5% curcuma was significantly better than that of rabbits fed on the control diet. The present results are agreement with those obtained by Ibrahim *et al.*, (2011) concluded that using ginger as feed additives in rabbit diets improved feed conversion ration of rabbits. Chattopadhyay (2004) concluded that

the better feed conversion of broiler chicks in group fed the turmeric supplemented diet may be due to its antioxidant properties then can stimulate protein biosyntheses within the experimental birds. Also, Longhout (2000) demonstrated that the positive results of ginger and turmeric supplemented diets could be related to the fact that the aromatic herbs have some growth promoting and anti-heat stress properties for growing birds and possibly they may have stimulating effect s on the animal digestive system.

Table (4): Cumulative feed consumption of Rabbit at the different ages as affected by natural feed additive and sex:

Treatment	Cumulative feed consumption (gm)			
	± SE at:			
	8-10 weeks	8-12 weeks	8-14 weeks	8-16 weeks
Feed additives:	NS	**	**	**
Control	752.25	1693.50 <sup>a</sup>	2551.00 <sup>a</sup>	3548.50 <sup>a</sup>
0.1 % Ginger	688.63	1440.50 <sup>b</sup>	2238.63 <sup>b</sup>	3242.38 <sup>b</sup>
0.5 % Curcuma	683.13	1422.50 <sup>b</sup>	2306.25 <sup>b</sup>	3246.25 <sup>b</sup>
Ginger + Curcuma	645.63	1334.38 <sup>b</sup>	2306.25 <sup>b</sup>	3226.88 <sup>b</sup>
SE	28.40	41.73	57.92	64.50
Sex:	NS	*	*	*
Male	714.94	1521.19 <sup>a</sup>	2419.63 <sup>a</sup>	3382.75 <sup>a</sup>
Female	669.88	1424.25 <sup>b</sup>	2281.44 <sup>b</sup>	3249.25 <sup>b</sup>
SE	20.08	29.51	40.96	45.61
Feed additives × Sex:	NS	NS	NS	*
Control × M	749.50	1672.00	2522.00	3467.00
Control × F	755.00	1715.00	2580.00	3630.00
0.1 % Ginger × M	719.00	1516.50	2327.75	3362.75
0.1 % Ginger × F	658.25	1364.50	2149.50	3122.00
0.5 % Curcuma × M	721.25	1491.25	2353.75	3268.75
0.5 % Curcuma × F	645.00	1351.75	2258.75	3223.75
Ginger + Curcuma × M	670.00	1405.00	2475.00	3432.50
Ginger + Curcuma × F	621.25	1263.75	2137.50	3021.25
SE	40.17	59.02	81.92	91.22

NS not significant, \* significant at 5% level, \*\* significant at 1% level

Means within the same classification had similar litter(s) are not significantly different (P<0.05)

The effect of sex on cumulative feed conversion of rabbits was not significant (p>0.05) at all age intervals studied (Table, 5). Similar trend was obtained by Okunlola (2014). The

effect on the interaction between natural feed additives and sex on cumulative feed conversion of rabbits at all age intervals was not significant Table (5).

Table (5): Cumulative feed conversion of rabbit at the different ages as affected by natural feed additive and sex:

Treatment	Cumulative feed conversion gm feed/gm weight gain ± SE at:			
	8-10 weeks	8-12 weeks	8-14 weeks	8-16 weeks
Feed additives:	**	**	**	**
Control	2.67 <sup>a</sup>	2.97 <sup>a</sup>	3.05 <sup>a</sup>	3.17 <sup>a</sup>
0.1 % Ginger	2.49 <sup>b</sup>	2.56 <sup>b</sup>	2.74 <sup>b</sup>	2.91 <sup>b</sup>
0.5 % Curcuma	2.33 <sup>c</sup>	2.40 <sup>c</sup>	2.62 <sup>c</sup>	2.76 <sup>c</sup>
Ginger + Curcuma	2.17 <sup>d</sup>	2.24 <sup>d</sup>	2.52 <sup>d</sup>	2.66 <sup>d</sup>
SE	0.07	0.034	0.025	0.025
Sex:	NS	NS	NS	NS
Male	2.37	2.51	2.71	2.87
Female	2.46	2.57	2.75	2.89
SE	0.05	0.02	0.017	0.017
Feed additives × Sex:	NS	NS	NS	NS
Control × M	2.50	2.86	2.98	3.16
Control × F	2.84	3.07	3.13	3.18
0.1 % Ginger × M	2.51	2.57	2.75	2.92
0.1 % Ginger × F	2.48	2.55	2.73	2.90
0.5 % Curcuma × M	2.32	2.39	2.60	2.74
0.5 % Curcuma × F	2.34	2.40	2.64	2.78
Ginger + Curcuma × M	2.16	2.22	2.52	2.65
Ginger + Curcuma × F	2.19	2.26	2.52	2.67
SE	0.10	0.05	0.04	0.04

NS not significant, \* significant at 5% level, \*\* significant at 1% level

Means within the same classification had similar litter(s) are not significantly different (P<0.05)

**Carcass characteristics:**

The effect of natural feed additives on carcass weight, dressing percentage, giblets weight and percentage and abdominal fat weight and percentage of rabbits was not significant (Table, 6). Similar results

were obtained by Omage *et al.*, (2007) using different levels on ginger waste meal, Basavaraj *et al.*, (2011b) using turmeric rhizome powder, Peiretti *et al.*, (2011) using curcuma longa , they reported that feed additives had no



significant effect of carcass parameters of rabbits.

**Economic efficiency:**

Data presented in table (7) showed also that net revenue and economic efficiency of rabbits fed diets containing natural feed additives were higher than those of the control group. Moreover, The relative economic efficiency of rabbits fed diets containing 0.1% ginger, 0.5%

curcuma and both 0.1% ginger and 0.5% curcuma was higher than that of the control group by 8.93, 9.70 and 9.35%, respectively. These results were agreement with those obtained by Oleforuh-Okoleh et al (2014) they found that the economic efficiency of feeding rabbit diets containing ginger powder was higher than those fed on the control diet.

Table (6): Effect of feed additives on carcass characteristics:

Traits	Control	Ginger	Curcuma	Ginger + Curcuma	S.E.	Sig..
Carcass weight (gm)	1506.37	1480.57	1481.45	1435.87	61.1	NS
Dressing %	63.89	62.31	63.38	62.04	0.89	NS
Giblets weight (gm)	67.67	67.67	64.92	64.38	2.37	NS
Giblets %	4.51	4.57	4.59	4.36	0.159	NS
Heart weight (gm)	5.40	6.30	5.60	5.30	0.32	NS
Heart %	0.36	0.42	0.38	0.37	0.02	NS
Kidney weight (gm)	12.73	12.28	12.10	10.82	0.84	NS
Kidney %	0.84	0.83	0.82	0.76	0.046	NS
Liver weight (gm)	49.53	49.08	47.18	46.17	1.82	NS
Liver %	3.31	3.31	3.20	3.23	0.136	NS
Abdominal fat weight (gm)	12.83	12.97	13.38	8.70	2.11	NS
Abdominal fat %	0.89	0.86	0.90	0.59	0.14	NS

NS not significant, \* significant at 5% level, \*\* significant at 1% level Means within the same classification had similar litter(s) are not significantly different (P<0.05)

Table (7): Effect of feed additives on economic efficiency.

Item	Control	Ginger	Curcuma	Ginger+Curcuma
Total feed intake / rabbit ( Kg )	3.55	3.24	3.25	3.23
Price of Kg feed (L.E.)	2.83	2.86	2.95	2.98
Total feed cost / rabbit	10.04	9.27	9.59	9.62
Price/Kg body weight (L.E)	25	25	25	25
Total body weight (Kg)	2.24	2.22	2.31	2.31
Total price / rabbit	56	55.5	57.75	57.75
Net revenue (L.E.)	45.95	46.23	48.16	48.13
Economic efficiency	4.57	4.99	5.02	5.01
Relative economic efficiency (%)	100	108.93	109.70	109.35

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### الملخص العربي

#### تأثير الإضافات الغذائية الطبيعية على أداء النمو وصفات الذبيحة للأرانب النامية

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أستخدم فى هذه التجربة 32 ذكر و 32 أنثى أرانب نيوزلندى أبيض قسمت عشوائيا الى 4 مجموعات كل مجموعة 8 ذكو و 8 إناث قسمت الى 8 مكررات. غذيت المجموعة الأولى على عليقة كمنترول والمجموعة الثانية والثالثة والرابعة على نفس العليقة مضاف إليها 0.1% زنجبيل و 0.5% كركم و خليط من 0.1% زنجبيل + 0.5% كركم على الترتيب. قدمت العليقة والماء الى الأرانب حسب الحاجة طوال فترة التجربة. أوضحت النتائج المتحصل عليها أن إضافة 0.1% زنجبيل و 0.5% كركم الى علائق الأرانب النامية أدى الى زيادة معنوية فى وزن الجسم والزيادة التراكمية فى وزن الجسم وتحسن معدل التحويل الغذائى التراكمى عند كل الأعمار المدروسة من 8 الى 16 وزن الجسم وإستهلاك الغذاء للذكور أعلى من الإناث عند كل الأعمار المدروسة. بينما لم يتأثر معدل التحويل الغذائى التراكمى بجنس الأرنب. لم يكن للإضافات الغذائية تأثيرا معنويا على صفات الذبيحة. سجلت إضافة الزنجبيل والكركم الى علائق الأرانب أعلى قيمة اقتصادية مقارنة بالكنترول.