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PRODUCTIVE PERFORMANCE OF GROWING RABBITS FED DIET CONTAINING DIFFERENT LEVELSOF TOMATO POMACE

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A B S T R A C T

The current work was conducted to study the effect of implementing different levels of dry tomato pomace (DTP) on performance of growing rabbits. Thirty six New Zealand White growing rabbits, seven weeks old with 762.50 g average live body weight, were randomly distributed to four treated groups, each one received a diet containing DTP of 0, 10, 15 or 20% for eight weeks experimental period. From the present results, there was no significant difference in digestibility coefficients of the DM, OM, CP, EE and NFE as well as in the feed conversion, TDN and DCP between the different feeding groups. The total and daily weight gains seemed to be significantly higher for rabbits on 15% DTP when compared to those of 10 and 20% DTP, but they did not differ from the control group. The highest growth rate came with rabbits on the 15% DTP followed by the control, then by the 10% DTP, while the lowest growth rate came with rabbits on the 20% DTP level. All carcass traits as well as moisture, crude protein, ash and fats content in meat carcasses did not differ significantly between rabbits on the different feeding diets. There was a non-significant difference in blood physical (Hb, PCV, RBC and WBC counts) and chemical (total proteins, albumin, total lipids and Ca^{++}) criteria of the DTP-treated groups when compared to those of the control group. While plasma cholesterol steadily increased, there was a gradual decrease in the AST and ALT enzymatic activities by increasing the DTP level from 10 to 20%. The highest net revenue came with the 15% DTP dependent diet comparing to that with the other feeding and control groups. In conclusion, DTP can be substituted in the diets of rabbits up to 20% without any adverse effect on the performance or carcass traits.

KEY WORDS: Blood biochemistry, Performance, Rabbit, Tomato pomace.

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1. I N T R O D U C T I O N

Tomato is one of the major vegetables which come next to potatoes in term of world production [16, 43]. Dried tomato pomace (DTP), as a by-product, is a mixture of tomato skin, pulp and crushed seeds that remain after the processing of tomato for juice, paste and/or ketchup [23-26, 44]. This by product remains from squeeze of tomato is rich in protein, energy and crude fiber. In addition, it contains more essential amino acids for rabbits as compared to alfalfa meal of good quality [3, 33]. It has been reported that tomato pomace is a good source of protein but may be limited in energy due to the high fiber content [15]. The tomato seeds protein was found to contain approximately 13% more lysine than soy protein [7]. By chemical analysis, **previous** authors [10, 18, 29, 40] showed that tomato-pomace has 91-92% DM, 17-22% CP, 10-29% CF, 7-12% EE, 5-11% ash and 26-31% NFE. According to Aghajanzadeh-Golshani et al. [2], the dried tomato pomace contains 22.6 to 24.1% protein, 14.5 to 15.7% fat and 20.8 to 30.5% fiber. It is a good source of vitamin

B_1 and a reasonable source of vitamin A and B_2.

The dried tomato pomace has been considered as a good source of protein for providing amino acids, especially lysine and natural pigments such as β- carotene and lycopene as well as a valuable source of α-tocopherol which is used as an antioxidant [19, 21]. A variety of epidemiological studies have suggested that intake of lycopene-containing foods is inversely related to the incidence of cardiovascular disease and cancer of different sites [38].

In the year 2006, the average annual production of tomato in Egypt was recorded to be 7.6 million tons resulting in production of 19% as by-product during manufacturing [16]. Unfortunately, a great part of this by-product is lost without utilization, in spite of its rich in protein, energy, crud fiber and amino acids which more benefit for the rabbit compared to alfalfa hay [1, 3].

According to Sayed and Abdel-Azeem [36], the dried tomato pomace can be introduced in the growing rabbits 'diet up to 20% without any problem on livestock growth performance [39] Depending on its physical condition, the dried tomato pomace could be allocated in properly formulated diets to replace alfalfa [4] or maize grain [1] up to the rate of 15-30% [28] without any adverse effect on the growth performance.

The present study was designed to identify the effect of tomato pomace on the growth performance, digestibility, carcass traits, the some blood hematological, biochemical and economic efficiency of growing rabbits fed diets containing different levels of tomato pomace.

2. MATERIAL AND METHODS

The present study was carried out in the Rabbit Research Laboratory, Animal &Fish Production Department, Faculty of Agriculture (Saba Basha), Alexandria University and the Arid Lands Cultivating Research Institute, City of Scientific Research and Application Technology during the period from April to Jun 2011. Thirty six New Zealand White growing rabbits, seven weeks old with 762.50 g average live body weight, were randomly distributed to four experimental treated groups (n=9) with 3 replicate (3 rabbits each). The experimental period extended for eight weeks. Groups 2, 3 and 4 were fed diets which contained different levels of dried tomato pomace by levels 10, 15 and 20%, while group one was served as a control group (Table, 2). All diet rations were formulated in a pellet form.

All experimental groups were kept under similar managerial and environmental condition in windowed rabbitry and housed in galvanized batteries (30L x 40W x 40H cm) provided with feeders and automatic drinkers. Diets and fresh water were ad-libitum.

Tomato pomace (TP) was dried by air for four days, and then it was crushed in a homogeneous before mixing with the other feedstuff ingredients which inclusion in the experimental diet.

Sample of the prepared tomato pomace was taken for estimating its chemical composition according to AOAC [6].

Rabbits live body weight (LBW), body weight gain (BWG) as (g/ rabbit/week) and feed intake (FI) as (g) feed intake/rabbit/week) were weekly recorded. Feed conversion ratio (FCR) was calculated as g feed intake / g weight gain. As well as, LBW, BWG, FI and FCR were determined per treatment group over all experimental growth period.

At the end of the experimental period, digestibility trial was carried out using four rabbits per experimental diet to determine the apparent digestibility of nutrients and nutritive value of the experimental diets. Rabbits were housed individually in metabolic cages to collect feces from each rabbit during seven consecutive days. The chemical analysis of diets and feces was conducted according to AOAC [6]. The digestible energy (DE)

values of the experimental diets were calculated using the equation of Schiemann et al. [37] as follows:

DE (Kcal/g) = $5.2X_1 + 9.51\ X_2 + 4.2\ (X_3+X_4)$. Where: X_1=DCP, X_2= DEE, X_3= DCF and X_4=NFE

At the end of the growth experimental period, four rabbits from each experimental group were randomly chosen and fasted for 12 hours then they weighted individually before slaughtering,. Rabbit were slaughtered by cutting the jugular vein. Blood samples were collected into dry clean centrifuge tubes containing drops of heparin and centrifuged for 15 min (3500 rpm) to obtain plasma, which was stored at –20 ºC for later analysis. Plasma total protein [5], albumin [12], total lipids [17], cholesterol [32], calcium [34] and aspartate amino transaminase and alanine amino transaminase enzymes [31] were determined. After complete bleeding, rabbits were weighed, skinned and eviscerated. Carcass, small intestine, caecum, heart, liver, spleen and kidney were immediately weighed. All organs were calculated in a percentage to the pre-slaughter weight.

To determine the economic efficiency (EEF) for the experimental growing rabbits, the amount of feed consumed during the entire experimental period of each treatment was multiplied by the price of the used ingredients in its corresponding diet (according to the local market price) to calculate the total feed cost. Meat cost was determined by multiplying the price of meat according to the local market at Jun 2011(22EP/kg). To obtain the net revenue, feed cost was subtracted from the meat cost. The values of (EEF) were calculated as the net revenue per unit of total feed cost [9].The relative economic efficiency was estimated by dividing the economic efficiency of each experimental group on the economic efficiency of the control multiplied by 100 [20].

For statistical analysis, data were analyzed by analysis of variance using the general linear model procedure in SPSS software [41]. Differences among means were determined using Duncan test [13].

3. RESULTS AND DISCUSSION

Data presented in table (1) showed that Chemical analysis (on dry matter basis)of tomato pomace revealed that it has 91.01% dry matter (DM), 96.76% organic matter (OM), 20.18% crude protein (CP), 8.97% ether extract (EE), 28.50% crude fiber (CF), 3.24% ash and 30.12% nitrogen free extract (NFE). From our results and previous literature it could be noticed that tomato pomace seems to differ in its nutritive composition dependence on the stage of growth maturity, species and soil types [22, 23, 30], as well as, the methods of tomato processing, management after harvest, growing conditions, geographic and climatic conditions [24]. Generally, our results did not grossly differ from that found by Hamza [18], Soltan [40], Parayad and Rashidi [27] except that the ash value which appeared to be lower. Crude fiber content of tomato pomace from our results was 28.5%and this percentage came in accordance with that reported by Devasena et al. [11].

Based on the chemical composition of tomato pomace as an agro-industrial by-product it could be suggested that tomato pomace might be considered as a preliminary indicator on the possibility of using as a feed ingredient in commercial growing rabbits' diets. The experimental diet was formulated so that all rabbit groups might have nearly constant main requirements (Table 2).

As shown from table (3), there was no significant difference in digestibility of the DM, OM, CP and NFE between the different experimental groups. However, significant difference was revealed in digestibility of the crude fiber which appeared higher in D1 (33.58 ± 1.90%) than that in D3 (27.95 ± 0.93%) when compared to C (28.87 ± 1.10 %) and D2 (28.77 ± 1.57 %) feeding groups. Our results are agreement with that of

Devasena et al. [11] which investigated the effect of tomato pomace with level 0,10 and 15% they found that there were no significant for DM, OM, NFE and NDF digestibility were observed, however there was significant difference for crud fiber digestibility. Sayed and Abdel-Azeem [36] did not find significant differences in the dry matter, crude protein and nitrogen free extract digestibility, while there were significant differences in the either extract or crude fiber digestibility between different experimental groups fed diet containing tomato pomace. On estimating the feeding value, a non-significant difference was noticed in the TDN and DCP between all feeding groups, a finding which supposed that the experimental diet is uniformly processed enough to be consumed eventually by all rabbits in the control and tomato pomace-treated groups.

Table 1 Proximate chemical analysis of tomato pomace

Nutrients	Percentage
Dry matter (DM)	91.01
Organic matter (OM)	96.76
Crude protein (CP)	20.18
Ether extract (EE)	8.97
Crude fiber (CF)	28.5
Ash	3.24
Nitrogen free extract (NFE)	30.12

Table 2 Composition and proximate chemical analysis of the experimental diets:

	Items	Experimental diets			
		C	D1	D2	D3
Physical composition:	Tomato pomace	0.00	10.00	15.00	20.00
	Alfalfa hay	30.00	20.00	15.00	10.00
	Wheat bran	8.00	10.70	12.20	13.70
	Barley	15.00	15.00	15.00	15.00
	Soya bean	12.70	10.00	8.50	7.00
	Yellow corn	30.00	30.00	30.00	30.00
	Molasses	3.00	3.00	3.00	3.00
	Lime stone	0.20	0.20	0.20	0.20
	Premix*	0.50	0.50	0.50	0.50
	Nacl	0.50	0.50	0.50	0.50
	Dl-methionin	0.10	0.10	0.10	0.10
	Total	100	100	100	100
	Price/kg	2.15	1.95	1.86	1.77
Chemical composition %:	Dry matter (DM)	93.44	93.43	93.53	93.60
	Organic matter (OM)	94.69	95.19	95.79	95.78
	Crude fiber (CF)	12.81	12.61	12.40	12.15
	Ether extract (EE)	1.96	1.45	1.70	2.09
	Crude protein (CP)	17.52	17.13	17.96	17.49
	Nitrogen free extract (NFE)	51.9	54.01	53.45	53.58

*Each kg of vitamin and mineral mixture contained: Vita. A 2000.000iu, E 10mg, B_1 400mg, B_2 1200mg, B_6 400mg, B_{12} 10mg, D_3 180000iu, Colin chloride 240mg, Pantothenic acid 400mg, Niacin 1000mg, Folic acid 1000mg, Biotin 40mg, Manganese 1700mg, Zinc 1400mg, Iron 15mg, Cupper 600mg, Selenium 20mg, Iodine 40mg and Magnesium 800mg.

The present results are in agreement with those of Tawfeek et al. [42] who reported that the nutritive value of the experimental ration expressed as TDN and DCP was insignificant affected by dietary treatments. As shown from table (3), there was no significant difference in digestibility of the DM, OM, CP and NFE between the different experimental groups. However, significant difference was revealed in digestibility of the crude fiber which appeared higher in D1 (33.58 ± 1.90%) than that in D3 (27.95 ± 0.93%) when compared to C (28.87 ± 1.10 %) and D2 (28.77 ± 1.57 %) feeding groups. Our results are agreement with that of Devasena, et al. [11] which investigated the effect of tomato pomace with level 0, 10 and 15% they found that there were no significant for DM, OM, NFE and NDF digestibility were observed; however there was significant difference for crud fiber digestibility. Sayed and Abdel-Azeem [36] did not find significant differences in the dry matter, crude protein and nitrogen free extract digestibilities, while there were significant differences in the either extract or crude fiber digestibility between different experimental groups fed diet containing tomato pomace. On estimating the feeding value, a non-significant difference was noticed in the TDN and DCP between all feeding groups, a finding which supposed that the experimental diet is uniformly processed enough to be consumed eventually by all rabbits in the control and tomato pomace-treated groups. The present results are in agreement with those of Tawfeek et al. [42] who reported that the nutritive value of the experimental ration expressed as TDN and DCP was insignificant affected by dietary treatments.

Table 3 Nutrient digestibility and feeding value (%) of the experimental diets.

Items	Experimental diets			
	C	D1	D2	D3
Nutrient digestibility %				
DM	73.57±1.31	73.39±0.46	72.71±0.98	72.97±1.78
OM	75.21±1.28	74.96±1.04	73.85±1.07	73.98±1.78
CP	76.47±1.37	73.97±0.38	74.45±1.28	73.65±2.26
EE	84.63±0.92	84.76±0.98	84.71±0.95	83.75±1.70
CF	28.87±1.10[b]	33.58±1.90[a]	28.77±1.57[b]	27.95±0.93[b]
NFE	85.35±1.88	84.51±1.35	83.17±1.14	84.89±1.78
Feeding value				
TDN(%)2	65.12±1.04	65.31±0.82	64.63±0.96	65.70±1.47
DCP(%)3	13.40±0.24	12.67±0.07	13.37±0.39	12.88±0.39
DE4 kcal/kg DM	2870.1±4.55	2870.4±3.48	2844.9±4.21	2889.3±6.57

[1] Figure in the same row having different superscripts were significantly different (P<0.05). TDN, Total digestible nutrients, DCP, Digestible crud protein and DE, Digestible energy.

Table 4: Productive performance of the rabbits fed the experimental diets.

Items	Experimental diets			
	C	D1	D2	D3
Initial body wt.(g)	773.33±52.69	743.89±60.31	798.33±64.30	734.44±51.65
Final body wt.(g)	1903.67±60.25	1791.11±100.4	1980.56±92.82	1757.00±83.62
Total wt. gain(g)	1130.33±48.46[a]	1047.22 ±55.98[b]	1182.22±57.98[a]	1022.56±46.72[b]
Daily wt. gain(g)	20.18±0.65[a]	18.70±0.69[b]	21.11±0.73[a]	18.26±0.49[b]
Daily feed intake(g)	70.26±2.09[a]	66.62±2.16[b]	71.05±1.96[a]	62.03±1.86[c]
Feed conversion	3.75±0.17	3.85±0.19	3.67±0.17	3.57±0.14
Growth rate %	146.16	140.78	148.09	137.54

[*] Figures in the same row having different superscripts were significantly different (P<0.05)

It is worthy to note that all experimental groups have commenced with a nearly similar initial body weight which ranged between 734.33 and 798.33 g (Table, 4). Although there was a remarkable increase in the final from the initial body weight for all feeding groups, a non-significant difference also occurred among the different feeding groups. This finding might be attributed to the great individuality in the final body weight among rabbits within the same group as being indicated by the presence of wide magnitude of the standard error of mean for all feeding groups (Table, 4). This finding came in accordance with that reported by Ahmed et al. [3] who did not detects any significant difference in the live weight between rabbits groups fed diets contained 10, 20 and 30% dried tomato pomace as a substitution for alfalfa. However, Sayed and Abdel-Azeem [36] indicated the presence of higher daily gains for rabbits fed the diet contained 20% dried tomato pomace; while rabbits fed on the 30% dried tomato pomace level recorded the lowest value of daily gain.

However, the total and daily weight gain seemed to be significantly higher for rabbits on D_2 (1182.22 ± 57.98 & 21.11 ± 0.73 g, respectively) than those either on D_1 (1047.22 ± 55.98 & 18.70 ± 0.69 g, resp.), but, came in accordance with those in the control (1130.33 ± 48.46 & 20.18 ± 0.65 g), resp. groups (Table, 4). This finding came in consequence to the change in the daily feeding intake which appeared significantly higher for rabbits on D_2 (71.05 ± 1.96 g) than those either on D_1 (66.20 ± 2.16 g) or D_3 (62.03 ± 1.86 g), but nearly similar to those in the control (70.26 ± 2.09 g) groups. Sawal et al. [35] found that the incorporation of tomato pomace of 0, 10 and 20% in the diet of rabbits increased feed intake and conversion efficiency decreased with increasing dietary tomato pomace content Abd El-Razik [1] reported that there were no significant differences in live body weight, total or daily weight gain between experimental rabbit groups feed diets containing 0, 5, 10% tomato pomace for 8 weeks.

In spite of the non-significant difference in the feed conversion between the different feeding groups, the highest growth rate came with rabbits on D_2 (148.09%) followed by the control (146.16%) and those on D_1 (140.78%), while the lowest came with those on D_3 (137.54%) groups (Table, 4). Caro et al. [8] and Peiretti et al. [29] showed that there was no significant differences in feed conversion ratio in the experimental groups feed diets with 10, 20, 30 or 40% tomato pomace. From this finding, it might be concluded that the experimental diet supplemented by 15% tomato pomace seems more efficient for growing rabbits as indicated by the presence of high total and daily gain as well as more beneficial growth rate. Generally speaking, with the exception of the lung weight, all carcass traits did not find any significant difference between the different feeding groups (Table, 5). The lung weight appeared significantly higher for rabbits on D_2 (0.80 ± 0.08 g) than that for those on either D_1 (0.59 ± 0.05 g) or D_3 (0.70 ± 0.04 g), but lower than that for control (0.92 ± 0.17 g) groups. This finding might explain the presence of high growth rate for rabbits on D2 associated with good respiration results in more food consumption and consequently high latent energy [37]. Alicata et al. [4] found no differences in carcass yield between two groups fed mixed ration based on barley without or with 20% TP partly replacing alfalfa meal. Ahmed et al. [3] showed that feeding rabbits on a diet containing 0, 10, 20 and 30% TP had no significant effect on percentages of each of carcass, giblets and alimentary tract weights. Abd El-Razik [1] revealed that carcass weight and dressing percentage values of rabbits did not differ significantly among groups fed (0, 5 and 10% Tomato Pomace). Sawal et al. [35] found that decreasing percentage was not affected by tomato pomace levels. Moisture, crude protein, ether extract and

ash content of meat of rabbit fed experimental diets are shown in table (6). Content of moisture, crude protein, ash and fats did not differ significantly between tomato pomace treated groups and the control group. Results revealed that the percentage of protein content of groups fed 15 and 20% tomato pomace inclusion diets was slightly increased compared to the control group. Data of meat fat content illustrated a decrease in fat content in all tomato pomace levels as compared to the control and the 15% level had the lowest fat content mean. El-Tayeb [14] showed that CP, EE and ash contents of rabbit's meat differed slightly with treatments (0, 8, 16 and 24% Tomato Pomace) and the differences were always not significant. Statistical analysis for some of blood hematological and biochemical parameters are presented in table (7). Fed growing rabbits on diets containing different levels of dried tomato pomace revealed an increase in blood hemoglobin content (Hb, as g/dl), packed cell volume (PCV %), red and white blood cell count (RBC and WBC, respectively) at any tested level compared to the control group and this effect was non-significant. As well as, it could be noticed that the previous measurements was increased with increase tomato pomace inclusion level until 15%, while, 20% level appeared to be slightly lower than the other two tomato pomace levels (10 and 15%). This finding is in agreement with that by Khedr and Abdel-Fattah [20] who reported that fed growing rabbits on diet containing tomato waste (from 14 up to 30%) showed non-fignificant increase in Hb content, PCV and RBCs count. Our results revealed that no apparent indication of health trouble could be happened due to fed rabbits on tomato pomace inculsion diets up to 20%.

Data showed that no significant effect was found due to feed growing rabbits on tomato pomace inclusion diets at any levels on plasma total protein, albumin and globulin concentration compared to the control group. Within tomato pomace treatment levels, 15% inclusion levels had the highest plasma TP, Alb and Glob concentrations compared to the control or the other tomato pomace levels (10 and 20%), while the 20% tomato pomace level had the lowest means in these points

Table 5: Carcass traits of New Zealand White rabbit fed experimental diets.

Items	Experimental diets			
	C	D_1	D_2	D_3
Dressed body wt.%	49.50 ±1.35 ^{Ns}	50.77 ±1.34 ^{Ns}	50.20 ±1.75 ^{Ns}	48.09 ±2.44 ^{Ns}
Frontal parts wt.%	20.31 ±0.51 ^{Ns}	20.91 ±0.29 ^{Ns}	19.66 ±0.29 ^{Ns}	20.20 ±1.03 ^{Ns}
Rear Parts Wt.%	20.00 ±0.37 ^{Ns}	20.45 ±0.58 ^{Ns}	20.22 ±0.66 ^{Ns}	19.71 ±1.06 ^{Ns}
Middle Parts wt.%	9.19 ±0.84 ^{Ns}	9.40 ±0.64 ^{Ns}	10.33 ±0.99 ^{Ns}	8.18 ±0.57 ^{Ns}
Small intestine wt.%	12.08 ±1.21 ^{Ns}	12.22 ±0.74 ^{Ns}	13.11 ±0.51 ^{Ns}	13.88 ±1.16 ^{Ns}
Caecum wt.%	0.04 ±0.002 ^{Ns}	0.04 ±0.007 ^{Ns}	0.05 ±0.01 ^{Ns}	0.05 ±0.02 ^{Ns}
Abdominal fat wt.%	0.47 ±0.19 ^{Ns}	0.66 ±0.11 ^{Ns}	0.75 ±0.17 ^{Ns}	0.79 ±0.47 ^{Ns}
External fat wt.%	0.22 ±0.08 ^{Ns}	0.30 ±0.05 ^{Ns}	0.36 ±0.03 ^{Ns}	0.34 ±0.18 ^{Ns}
Heart wt.%	0.30 ±0.04 ^{Ns}	0.29 ±0.02 ^{Ns}	0.31 ±0.04 ^{Ns}	0.30 ±0.03 ^{Ns}
Lung wt. %	0.92 ± 0.17^{a}	0.59 ± 0.05^{b}	0.80 ± 0.08^{a}	0.70 ± 0.04^{a}
liver wt.%	3.75 ±0.27 ^{Ns}	2.98 ±0.09 ^{Ns}	3.10 ±0.25 ^{Ns}	3.32 ±0.64 ^{Ns}
Spinal wt.%	0.07 ±0.01 ^{Ns}	0.08 ±0.01 ^{Ns}	0.08 ±0.01 ^{Ns}	0.08 ±0.004 ^{Ns}
Kidney wt.%	0.76 ±0.08 ^{Ns}	0.74 ±0.03 ^{Ns}	0.70 ±0.05 ^{Ns}	0.71 ±0.04 ^{Ns}

* Figure in the same row having the same superscripts are not significantly different (P<0.05)

Table 6: Chemical composition of Rabbits meat fed experimental diets.

Items (%)	Experimental diets			
	C	D_1	D_2	D_3
Moisture	72.43 ±0.52^{Ns}	73.28 ±0.39 ^{Ns}	72.52 ±0.64 ^{Ns}	72.10 ±0.90 ^{Ns}
Crude protein	21.03 ±0.71 ^{Ns}	21.46 ±0.22 ^{Ns}	22.12 ±0.35 ^{Ns}	22.13 ±0.73 ^{Ns}
Ash	1.25 ±0.13^{Ns}	1.15 ±0.19^{Ns}	1.29 ±0.12^{Ns}	1.29 ±0.13^{Ns}
Fat	5.29±0.72 ^{Ns}	4.16 ±0.32 ^{Ns}	4.07 ±0.44 ^{Ns}	4.48 ±0.49 ^{Ns}

* Figure in the same row having the same superscripts are not significantly different (P<0.05)

Our results are in a good agreement with the results of Khedr and Abdel-Fattah [20] who showed that TP and albumin did not differ between groups received tomato waste in their diets and the control group.

Blood calcium concentration in tomato pomace treatment groups was non-significantly increased compared to the control group and this effect was apparent with the high two levels (15 and 20%) than the low level (10%).

From data it could be noticed that fed growing rabbits on tomato pomace inclusion diets resulted in a significant increase in plasma cholesterol concentration compared to the control group and this effect was attributed to tomato pomace-level. On the other hand, adding dried tomato pomace to rabbit's diet at any level resulted in a non-significant reduces plasma total lipids compared to the control group and this was higher with 15% inclusion level. Decrease plasma total lipids concentration in tomato pomace groups was attributed to increase lipid metabolism and transfer these lipids from blood to adipose tissues, whereas, the abdominal fat and fat tissues under neck-skin were increased in treated groups compared to the control and had the same plasma total lipids trend.

Data of serum transaminases (AST and ALT) activities are presented in (Table 7). Results revealed that adding tomato pomace to growing rabbits 'diets at any levels generally resulted in decrease liver AST and ALT enzymes activities compared to the control group. In regard to AST activity, data indicated that there were no significant decreases in AST enzyme activity when rabbits were fed diets containing different levels from tomato pomace compared to the control group. In contrast, there were a gradually decrease in ALT enzyme activity in tomato pomace treated groups compared to the control group and this effect was tomato pomace-level dependent. Addition of dried tomato pomace by level 20% to growing rabbits diet resulted in a significant ($P< 0.05$) decrease in the serum ALT enzyme activity when compared either to those fed control diet or those put on 10 and 15% tomato pomace levels diets. According to Khedr and Abdel-Fattah [20], addition of tomato waste to rabbits' diets had no adverse effect on AST and ALT enzymes activities and this result was in accordance with our finding.

As shown from table (8), by multiplying the total feed intake, for all rabbits in the same feeding group, in the feed price, actually present in the local market, the total feed cost results.

Table 7: Effect of different levels of tomato pomace in rabbits' diet on some hematological and biochemical parameters.

Item/Group	Treatment			
	Control	D1	D2	D3
Hb (g/dl)	11.50 ±0.29	12.50 ±0.65	13.00 ±1.00	11.75 ±0.25
PCV (%)	34.27 ±0.86	37.25 ±1.92	38.74 ±2.98	35.02 ±0.75
RBCs (n x10^6/ml)	3.80 ±0.10	4.13 ±0.21	4.29 ±0.33	3.88 ±0.08
WBCs (n x10^3/ml)	3.75 ±0.17	4.53 ±0.44	4.70 ±0.21	4.28 ±0.39
Total protein (g/dl)	10.07±0.24	9.93±0.57	10.78±0.41	9.32±0.76
Albumin (g/dl)	2.33±0.08	2.51±0.08	2.59±0.15	2.38±0.06
Globulin (g/dl)	7.75±0.18	7.42±0.51	8.19±0.44	6.94±0.71
Calcium (g/dl)	2.28±0.60	2.31±0.55	2.68±0.61	2.61±0.49
Cholesterol (mg/dl)	90.63±6.09^b	93.26±11.19^b	103.06±15.19^{ab}	139.40±19.63^a
Total lipid (mg/dl)	396.29±53.64	385.59±20.10	324.56±6.51	378.82±48.44
ALT (U/I)	50.50±6.81	36.00±4.92	39.25±4.17	36.75±6.18
AST (U/I)	80.50±7.58^a	75.50±9.73^a	64.75±8.73^{ab}	47.75±6.86^b

* Values (Mean±S.E.) in the same row having different superscripts were significantly different ($P<0.05$)

Table 8: Economic efficiency of growing rabbits fed experimental diet

Item/Group	Unit	Experimental diets			
		Control	D_1	D_2	D_3
Cost / ton diet	LE	2150	1950	1860	1770
Mean final body wt.	kg.	1904	1791	1981	1757
Mean daily feed intake	g.	70.26	66.62	71.05	62.03
Total feed intake	kg.	3.92	3.752	3.976	3.472
Initial price/rabbit[1]	LE	17.01	16.37	17.56	16.16
Care cost/rabbit	LE	0.8	0.8	0.8	0.8
Feed cost/rabbit	LE	8.43	7.32	7.40	6.15
Total cost/rabbit[2]	LE	26.24	24.49	25.76	23.11
Total revenue/rabbit[3]	LE	41.89	39.40	43.58	38.65
Net revenue/rabbit[4]	LE	15.65	14.92	17.83	15.55
Economic efficiency[5]		0.596	0.609	0.692	0.673
Relative economic efficiency[6]		100	102.20	116.13	112.91

[1] Initial price/rabbit=Average initial weight of weaned rabbits at start of the experiment X selling price/kg. [2] Total cost per bunny=Total feed cost + Management of bunny (L/E) + bunny price (at the start of the experiment, L.E.). [3] Total revenue per bunny (L.E.) = Final body weight (Kg) X Selling price of Kg bunny, live body weight (L.E.). [4] Net revenue per bunny (L.E.) = Total revenue per bunny (L.E.) - (total costs per bunny (L.E.). [5] Economic efficiency=Net revenue per bunny (L.E.)/Total costs per bunny (L.E.). [6] Relative economic efficiency=Economic efficiency of each experimental group/economic efficiency of the control X 100

By dividing the total weight gain, after eight weeks experimental period, on the market selling price (22 EP/ kg), the selling price of gain derives. By subtracting the total feed cost from the selling price of gain, the net revenue is obtained. The economic efficiency results from dividing the net revenue on the total feed cost.

4. CONCULOSIONS

Looking through the results obtained, It has been emphasized that tomato pomace supplementation in rabbit diet produces more economic efficiency than that in the control. Also, addition of tomato pomace at 15% concentration gives the highest net revenue in comparison to the control and other groups. The result obtained in this study showed that the dried tomato pomace can be substituted in the diets of rabbits without any adverse effect on the performance and carcass traits beside it have an economical value.

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مجلة بنها للعلوم الطبية البيطرية
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الأداء الإنتاجي للارانب النامیه المغذاه بعلائق تحتوى علي مستويات مختلفة من تفل الطماطم

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الملخص العربى

أجريت هذه الدراسة بمزرعة أبحاث الارانب بقسم الانتاج الحيوانى والسمكى بكلية الزراعة سابا باشا جامعة الاسكندرية ومعهد بحوث الأراضي القاحله ,مدينة الابحاث العلمية والتطبيقات التكنولوجيه خلال الفترة من شهر ابريل الى يونيو 2011 وتهدف هذه الدراسة لمعرفة تأثير تغذية الارانب على علائق محتوية على مستويات مختلفة من تفل الطماطم، واستخدم في هذه الدراسة عدد 36 أرنب نامي عمر 7 أسابيع بمتوسط وزن 762.5 جم وزعت عشوائيا على 4 مجاميع كل مجموعة منها تحتوى على 3 مكررات وكل مكررة تحتوى على 3 أرانب وأستمرت التجربة لمدة ثمانى أسابيع،غذيت المجموعة الاولى على العليقة الاساسية (كنترول)، بينما المجموعة الثانية والثالثة والرابعة غذيت على علائق تحتوى على نسب مختلفة من تفل الطماطم بمستويات 10، 15 و20 %على الترتيب. ويمكن تلخيص أهم النتائج المتحصل عليها كما يلي: 1) أوضح التحليل الكيميائي لتفل الطماطم أنه يحتوى على 91,01% مادة جافة، 96,76% مادة عضوية،20,18% بروتين خام،8,97% مستخلص ايثيري،28,5% الياف خام، 3,24% رماد،30,2% كربوهيدرات ذائبة على الترتيب. 2) لم توجد هناك اى فروق معنوية في معاملات هضم المادة الجافة،المادة العضوية،البروتين الخام،الكربوهيدرات الذائبة بين المجاميع التجريبية المختلفة بينما كان هناك فرق معنوى في معاملات هضم الالياف التى كانت أعلى في المجموعة المغذاه على العليقة المحتوية على 10% تفل طماطم بالمقارنة بالمجاميع الأخري. 3) بالنسبة للزيادة الكلية في وزن الجسم والزيادة اليومية كانت أعلى للأرانب المغذاه على العليقة المحتوية على 15% تفل طماطم عن المجموعة المغذاه على مستوي 10 أو 20% تفل طماطم. 4) حدث تحسن غير معنوي في الكفائه التحويليه (كجم علف / كجم لحم) في المجاميع المغذاه علي تفل الطماطم مقارنه بمجموعة الكنترول و هذا التحسن كان يزداد مع زياده مستوي الأضافه من تفل الطماطم. 5) لم يكن هناك أى فروق معنوية بالنسبة الى صفات الذبيحة بين المجاميع المختلفة. 6) لم يختلف محتوى اللحم من الرطوبة، البروتين، الدهون والاملاح المعدنيةمعنويا في لحوم الارانب المغذاه على العلائق التجريبية المختلفة. 7) حدثت زياده طفيفه و غير معنويه في مستوي هيموجلوبين الدم ,PCV, عدد كرات الدم الحمراء و عدد كرات الدم البيضاء في المجاميع المغذاه علي تفل الطماطم مقارنه بالكنترول. 8) لم يكن هناك تأثير لاضافه تفل الطماطم إلي علائق الأرانب الناميه علي كل من مستوي بروتينات , البيومينات و مستوي كالسيوم الدم مقارنة بمجموعه الكنترول. 9) مستوي الدهون الكليه في الدم لم يتأثر معنويا نتيجة لأضافة تفل الطمام مقارنة بمجموعة الكنترول في حين حدثت زياده تدريجية في مستوي الكوليسترول مع زياده مستوي الأضافة مقارنة بالكنترول و هذه الزياده كانت معنويه مع مستوي 20% من تفل الطماطم. 10) اضافة تفل الطماطم الى علائق الارانب بأى نسب في التجربة أدى الى انخفاض نشاط انزيمات الكبد وكانت تلك الاختلافات معنوية مع انزيم.AST . 11) إضافة تفل الطماطم عند مستوى 15% أعطى أعلى عائد إقتصادى بالمقارنة بالمجموعة المغذاه على العليقة الكنترول. 12) نستخلص من هذه الدراسة أن تفل الطماطم المجفف ممكن إدخاله في علائق الارانب بدون أى تأثيرات عكسية على الأداء الانتاجى وصفات الذبيحة .

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