

EFFECT OF USING DRIED TOMATO POMACE IN GROWING RABBIT DIETS

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SUMMARY

A total number of sixty unsexed New Zealand White (NZW) weaned rabbits at five weeks of age with an average initial body weight of 625.8 ± 15.5 g were used to study the effects of using dried tomato pomace (DTP) at different levels on growth performance, digestibility of nutrients, blood parameters, carcass traits and economic efficiency. Rabbits were randomly assigned to four experimental groups of fifteen rabbits with five replicates of three animals each. The first group was fed the control diet without DTP while the second, third and fourth groups were fed diets containing 15, 30 and 45% DTP, respectively. The results indicated that using DTP up to 30% gave significant increase of live body weight (LBW) and daily weight gain (DWG) compared with either 45% DTP or control diet at 9 and 13 weeks of age. However, rabbits fed 15 % DTP recorded the highest BW and DWG during the whole experimental period. Daily feed consumption (DFC) and feed conversion ratio (FCR) were not significantly affected by using DTP up to 30%, while group fed 45 % DTP gave the best FCR with low DFC compared with control group at the end of the experimental period. There were improvements of DM, OM, CP and NFE digestibility coefficients by using different levels of DTP compared to control group while EE digestibility was not affected. In the same trend nutritive values (DCP and TDN) gave the best results at all treated DTP levels compared with control group. There were no significant differences between all levels of DTP and control group in dressing and carcass weight percentages. Giblets and liver weight percentages were significantly higher in rabbits fed control diet compared with those fed 30 % and 45 % DTP while there were no significant differences between different groups in other carcass characteristic values. The results showed that there were no significant effects of dietary DTP levels on total plasma proteins, albumin, globulin, A/G ratio and urea-N concentration compared with control group. Total plasma cholesterol was significantly reduced by feeding rabbit diets containing DTP up to 30.0%. On the other hand, rabbits fed diet contained 45% DTP recorded higher value for total plasma lipids compared with 0, 15 and 30% DTP groups. Liver enzyme activities were significantly reduced in groups fed either 15 or 30% DTP than those fed control and 45%DTP diets. Using DTP in the diet of the rabbits significantly improved the percent and relative economic efficiency and performance index than those received control diet.

In conclusion, the results indicated that using dried tomato pomace up to 30% in growing rabbit diets can improve the productive performance, nutrients digestibility coefficients, blood components and the economic efficiencies.

Keywords: rabbit, tomato pomace, performance, digestibility, carcass, blood

INTRODUCTION

Recently, increasing the price of conventional feed ingredients and its shortage are the major limiting factors for continuous and development of poultry industry. Therefore, there is urgent needs to search for alternative ingredients which could be used as cheap sources to partial or full replacement. Studies were carried out by many investigators for evaluating some new ingredients used in rabbit diets. The information are still lacking about the methods of production and the composition of these new ingredients in rabbit diets represent one of the major items of cost. Moreover, 21 million tons of agriculture crop residues are produced in Egypt annually (Deraz, 1996). However, only 4.0 to 4.3 million tons of these crop residues are used for feeding animals (El-Shinnawy, 1990; Hathout and El-Nouby, 1990 and Khorsheed, 2000). Agro-industrial by-products such as tomato wastes could be used as a new alternative feedstuff in the growing rabbit diets. The total solid waste is estimated to be 19% of the total solids in original tomatoes. The total tomato waste from world production is roughly estimated to be 3.7 million tons/year (FAO, 1991). The disposal of tomato processing waste is still a great problem in many countries. If this waste could be processed, dried and sold as feedstuff, the problem of its accumulation and pollution would be solved and a benefit would be introduced in the developing market (El Boushy and Van der Poel, 1994). On the other hand, dried tomato pomace, a

byproduct of tomato processing, is an excellent source of α -tocopherol (vitamin E), which is used as an antioxidant (King and Zeidler, 2004) and effectively decreases oxidative stress by decreasing the concentration of malondialdehyde (MDA) formation in the body and by protecting mononuclear blood cells against increased DNA damage (Pajk et al, 2006). There were some previous attempts to using tomato waste in rabbit diets by many investigators (Gippert *et al.*,1989; Ahmed *et al.*,1994; Abd El-Razik, 1996 and Devasena *et al.*, 2007) who reported that, rabbit fed 10-20% tomato waste gave the highest growth rate, performance index and feed utilization.

The present study was designed to evaluate the possibility of incorporating different levels of tomato waste in growing rabbit diets on growth performance, digestibility of nutrients, blood parameters, carcass traits and economic evaluation.

MATERIALS AND METHODS

The experimental work of present study was carried out at the Centre of Agricultural Studies and Consultations (CASC), Rabbits Production Unit (RPU), Faculty of Agriculture, Ain Shams University, Cairo, Egypt. Fresh tomato pomace used in this experiment was obtained from Heinz Company, air dried , finely ground and thoroughly homogenized before mixing with the other ingredients of the diets.

Experimental rabbits:

Sixty, unsexed, New Zealand White (NZW) weaned rabbits of 5 weeks of age with an average initial body weight of 625.8 ± 15.5 g were randomly divided into four experimental groups (15 rabbits/group). Each group was subdivided into five replicates, each of 3 rabbits and the initial live body weights of all experimental groups were almost equal.

Experimental diets:

Four isocaloric, isonitrogenous and almost isofibrous diets were formulated in which tomato waste (seeds and skins) was incorporated at levels of 0, 15, 30 and 45%. All experimental diets were formulated at Atmida company to meet the recommended nutrient requirements of rabbits according to NRC (1977) and Cheeke (1987). Ingredients and chemical composition of the experimental diets are shown in Table (1).

Management:

The experimental rabbits were housed in galvanized metal wire cages. Each cage was 60 x 50 x 40 cm for length, width and height respectively, and provided with feeders and automatic watering system, with three rabbits per each cage. The cages were located in a naturally ventilated and lighting building. The experimental diets were offered to the rabbits ad libitum and fresh water was available all the time during the experimental period. Rabbits were individually weighed at the beginning of the experiment, then at weekly intervals until the end of the experiment. Daily weight gain, daily feed consumption, feed conversion ratio and mortality rate were calculated. The feeding trial was continued for 8 weeks.

Digestibility trials :

At the last week of the experiment, digestibility trials were conducted using 20 rabbits (five rabbits from each treatment group), which were housed individually in metabolic cages that allow faeces and urine separation. The preliminary period continued for 7 days and the collection period extended for 5 days. Feed intake was exactly determined. Faeces were collected daily, weighed and dried at 60-70°C for 24 hours, bulked, finely ground and stored for chemical analysis.

Carcass characteristics and blood samples :

At the end of the growth trial, five randomly chosen rabbits representing each group were slaughtered according to the standard technique of Cheeke et al., (1987). Dressing percentage included relative weights of carcass, giblets and head. Blood samples were collected at slaughtering in un-heparinized glass tubes (5 samples/treatment group). Blood serum was separated by centrifugation at 3000 rpm for 15 minutes. The collected serum was stored at -20°C until assay. Values of total protein, albumin, total lipids, total cholesterol, and urea-N, and transaminase enzyme activities (AST and ALT) were determined by using kits purchased from Diamond Diagnostics Company, Egypt. The globulin values were obtained by subtracting the values of albumin from the corresponding values of total proteins.

Chemical analysis:

The chemical composition of the dried tomato pomace (DTP), experimental diets and faeces were

Table (1): Composition and chemical analysis of the experimental diets.

Ingredients (%)	Levels of dietary dried tomato pomace in the diets			
	0.0%	15.0%	30.0%	45.0%
Clover hay	29.00	16.00	2.50	0.00
Barley	21.00	20.00	20.00	12.00
Yellow corn	5.00	10.00	9.00	8.00
Wheat bran	27.00	24.00	26.00	24.00
Dried tomato pomace	-	15.00	30.00	45.00
Soybean meal (44% CP)	15.70	12.00	8.00	3.50
Vegetable oil	0.25	0.25	1.30	4.00
Limestone	0.80	1.25	1.65	1.65
Dicalcium phosphate	0.60	0.90	1.00	1.30
Premix*	0.30	0.30	0.30	0.30
Common salt (NaCl)	0.25	0.25	0.25	0.25
DL-Methionine	0.10	0.05	0.00	0.00
Total	100.00	100.00	100.00	100.00
Chemical analysis (as fed basis)				
<u>A- Determined analysis: -</u>				
Dry matter (DM%)	92.02	92.30	92.60	92.71
Organic matter (OM%)	83.92	83.80	83.93	84.00
Crude protein (CP%)	16.90	16.85	16.93	16.85
Crude fiber (CF%)	14.00	14.25	14.30	15.60
Ether extract (EE%)	3.48	3.52	3.95	5.48
Nitrogen free extract (NFE%)	49.54	49.18	48.75	46.07
Crude ash (%)	8.10	8.50	8.67	8.71
<u>B- Calculated analysis:-</u>				
DE (kcal/kg)	2549	2542	2556	2558
Methionine + cystine (%)	0.68	0.67	0.66	0.69
Lysine (%)	0.95	0.91	0.87	0.86
Calcium (%)	0.94	0.99	0.98	0.98
Total phosphorous (%)	0.61	0.62	0.61	0.60

* Each Kilogram of premix contains: 2000.000 IU vit. A, 150.000 IU vit. D, 8.33g vit. E, 0.33g vit. K, 0.33g vit. B1, 1.0g vit. B2, 0.33g vit. B6, 8.33g vit. B5, 1.7 mg vit. B12, 3.33g Pantothenic acid, 33mg Biotin, 0.83g Folic acid, 200g Choline chloride, 11.7g Zn, 12.5g Fe, 16.6 mg Se, 16.6 mg Co, 66.7g Mg and 5g Mn.

analyzed according to A.O.A.C. (1996). Dried tomato pomace was analyzed for fiber fractions, neutral detergent fiber (NDF), acid detergent fiber (ADF) and acid detergent lignin (ADL) using Tecator Fibretic System according to Goering and Van Soest (1970) procedures. Hemicellulose was calculated as the difference between NDF and ADF, while cellulose was calculated as the difference between ADF and ADL. Amino acids concentrations were measured using a Bekman 7300 High performance Amino Acids Analyzer according to the methods of AOAC (1996) at the CLFF, Agriculture Research Center, Giza, Egypt. The total digestible nutrients (TDN) were calculated according to the classic formula (Cheeke et al., 1982). The apparent digestibility coefficients of DM, OM, CP, CF, EE and NFE for the tested diets were estimated.

Economic efficiency (EEf) :

The EEf was calculated according to the following equation: $EEf = A/B \times 10$, where A is selling cost of obtained gain (LE per kg) and B is the feeding cost of this gain. The performance index (PI) was calculated according to the equation described by North (1981) as follows: $PI = \text{Live body weight (Kg)} / \text{Feed conversion} \times 100$

Statistical analysis:

Data were statistically analyzed by using SAS program (1998). According to the following model. $Y_{ij} = \mu + T_i + e_{ij}$
Where: Y_{ij} = The observation on the i^{th} treatment μ = Overall mean T_i = Effect of the i^{th} treatment e_{ij} = Random error treatment. Duncan's Multiple Range test (1955) was also used for the comparison

among means of the experimental groups.

RESULTS AND DISCUSSION

Chemical analysis of dried tomato pomace (DTP) :

The proximate analysis of DTP is presented in Table (2). It is shown that, the DTP has reasonable amounts of protein and nitrogen free extract and high amount of crude fiber, particularly cellulose and lignin. Moderate amounts of ash and low amount of EE were also found. The present values of DTP are within the results reported by El-Sayed (1994), Alicata et al.(1996) and Soltan (2002). Values of cell wall constituents of DTP used in this study are generally within the published ranges reported by El-Sayed (1994). The results of amino acid contents (Table 2). These results of DTP used in this study were rich in most essential amino acids and within the published ranges of Persia et al.(2003). From the chemical analysis results, it is obvious that DTP is rich in most nutrients and could be a good feedstuff with high nutritive value.

Productive Performance:

The data presented in Table (3) showed that using of tomato waste (DTP) up to 30% gave higher LBW and DWG compared with either those fed control or 45.0% DTP diets at 9 and 13 weeks of age. However, rabbits fed 15 % DTP recorded the highest LBW and DWG during the whole experimental period. Daily feed consumption at the end of the experiment was not significantly affected by using DTP up

Table (2): Composition and chemical analysis of the tomato pomace.

A- Proximal analysis (%)		C- Amino acid contents (%)	
Dry matter (DM%)	92.71	Methionine	1.51
Organic matter (OM%)	83.65	Cystine	0.42
Crude protein (CP%)	22.3	Lysine	1.19
Crude fiber (CF%)	28.93	Threonine	0.70
Ether extract (EE%)	3.67	Arginine	1.49
Nitrogen free extract (NFE%)	28.75	Isoleucine	0.89
Crude ash (%)	9.06	Leucine	1.36
DE (kcal/kg)*	2001	Valine	0.85
B- Fiber fractions (%)		Histidine	0.87
		Phenylalanine	0.78
		Glycine	1.16
NDF	73.01	Serine	1.03
ADF	52.96	Alanine	0.72
ADL	22.92	Aspartic acid	2.24
Hemicellulose	20.05	Glutamic acid	3.36
Cellulose	30.04	Proline	1.09

* The digestible energy (DE) was calculated according to Fekete and Gippert (1986) by applying the equation

$$DE \text{ (kcal/kg)} = 4253 - 32.6 \text{ (CF \%)} - 144.4 \text{ (total ash \%)}.$$

Table (3): Effect of feeding different levels of dried tomato pomace (DTP) on productive performance of growing rabbits.

Items	Control	15%DTP	30%DTP	45%DTP	Sig.
No. of rabbits	12	12	12	12	
<u>Live body weight (g)</u>					
5 weeks	626.10±3.67	626.20±2.15	625.23±4.05	625.63±11.62	NS
9 weeks	1305.00 ^b ±55.8	1632.50 ^a ±5.8	1546.11 ^a ±33.4	1328.33 ^b ±39.2	**
13 weeks	1903.33 ^c ±22.6	2219.17 ^a ±15.8	2067.78 ^b ±34.2	1873.32 ^c ±24.4	**
<u>Daily weight gain (g)</u>					
5-9 weeks	25.24 ^b ±1.87	35.94 ^a ±0.56	32.89 ^a ±1.29	25.10 ^b ±1.03	**
9-13 weeks	21.37±1.34	20.96±0.36	18.63±0.10	19.47±0.55	NS
5-13 weeks	22.81 ^c ±0.34	28.45 ^a ±0.11	25.76 ^b ±0.66	22.28 ^c ±0.24	**
<u>Daily feed consumption (g)</u>					
5-9 weeks	73.07 ^b ±2.13	87.89 ^a ±1.28	77.30 ^{ab} ±4.05	61.31 ^c ±3.29	**
9-13 weeks	104.90 ^{ab} ±2.24	112.86 ^a ±7.51	118.12 ^a ±0.49	91.47 ^b ±6.62	*
5-13 weeks	88.99 ^a ±1.82	100.37 ^a ±4.39	97.71 ^a ±1.79	76.39 ^b ±4.77	**
<u>Feed conversion ratio (g feed/ g gain)</u>					
5-9 weeks	3.04 ^a ±0.14	2.45 ^b ±0.08	2.35 ^b ±0.07	2.45 ^b ±0.03	**
9-13 weeks	4.95 ^b ±0.35	5.39 ^{ab} ±0.27	6.34 ^a ±0.05	4.72 ^b ±0.44	*
5-13 weeks	3.90 ^a ±0.02	3.53 ^{ab} ±0.17	3.79 ^{ab} ±0.05	3.43 ^b ±0.18	*
<u>Survival rate (%)</u>					
5-13 weeks	100	100	100	100	

^{a, b, c} Means within the same row with different superscripts are significantly different, Sig. =Significance

NS=Non Significant, * (P≤0.05), ** (P≤0.01)

to 30.0% compared with control group while DTP at 45.0% gave the lowest value. Feed conversion ratio was not significantly affected by using DTP up to 30.0% while group fed 45.0% gave the best value at the end of the experimental period. Using DTP during the first period (5-9 weeks of age) gave significant improvements in FCR compared with control group while the groups fed 15.0% and 30.0% gave the best values compared with those fed either control or 45.0% DTP diets at the second period (9-13 weeks of age). The improvement of daily weight gain and feed conversion in groups fed DTP up to 30% may be due to its highly in the most essential amino acids. These results were in agreement with those reported by Ahmed *et al.* (1994) and Abd El-Razik (1996) who found that feed conversion was improved in rabbit fed 10 and 20% DTP. Devasena *et al.* (2007) found that diets containing dried tomato pomace (DTP) for rabbits at 0, 10 and 15% had no significant difference in final body weight and body weight gain, while daily feed intake was significantly increased by increasing the level of DTP. On the other hand, Rojas *et al.* (1989) found that there was no significant difference in weight gain or feed conversion among the groups fed 0, 10 and 20% DTP. It is interesting to notice that, the mortality rate during all the periods of growth was zero among experimental treatments. This may be an indication that growing rabbits can tolerate different dietary levels of DTP used in this study. This result agreed with those reported by Abd El-Razik (1996) who found that, no mortality rate was observed in the groups of rabbits fed diets contained DTP.

Nutrients digestibility coefficients and nutritive values:

Digestibility coefficients of nutrients and nutritive values of the experimental diets are presented in Table (4). The results indicated that there were improvements of DM, OM, CP, CF and NFE coefficients by using different levels of DTP compared to control group while EE digestibility was not affected. In the same trend nutritive values (DCP and TDN) gave the best values at all treated levels of DTP compared with the control group. Improvement of CP digestion may be due to by the difference in the content of digestible dietary fiber and/or changes in the origin of starch and protein (Blas *et al.*, 1990 and Gidenne and Perez, 1993).

These results agree with Sawal *et al.* (1996) who reported that digestibility of CF and TDN values were increased with DTP incorporation in rabbit diets up to 20%. On the contrary to the results of this study, Devasena *et al.* (2007) found that there were no significant differences for DM, OM, CP and NFE digestibility.

Carcass characteristics:

Carcass traits and dressing percentage results are shown in Table (5). The results indicated that, there were no significant differences between all levels of DTP and control group in dressing and carcass weight percentage when compared to the control group. Group fed 45.0% DTP gave significantly lower values of formentioned traits compared with other DTP levels (15.0% and 30.0% DTP). Giblets and liver weight percentages were significantly higher in group fed

Table (4): Effect of feeding different levels of dried tomato pomace (DTP) on digestibility coefficients and nutritive values of growing rabbits.

Item	Control	15%DTP	30%DTP	45%DTP	Sig.
<u>Nutrients digestibility Coefficients %:</u>					
Dry matter	64.63 ^b ±1.69	70.98 ^a ±0.77	67.88 ^{ab} ±1.70	71.28 ^a ±1.06	**
Organic matter	64.32 ^b ±1.79	70.29 ^a ±0.78	67.79 ^{ab} ±1.43	69.79 ^a ±1.26	*
Crude protein	68.74 ^b ±1.22	75.65 ^a ±1.02	69.21 ^b ±3.31	70.55 ^{ab} ±1.05	*
Ether extract	74.01±1.67	72.98±2.46	76.10±0.97	70.89±2.70	NS
Crude fiber	36.59 ^c ±1.76	43.95 ^a ±1.30	40.60 ^{ab} ±0.59	38.04 ^c ±0.69	**
NFE	72.50 ^b ±2.03	76.59 ^a ±0.61	76.03 ^{ab} ±1.05	79.59 ^a ±0.90	**
<u>Nutritive values (%):</u>					
DCP	11.57 ^b ±0.20	12.75 ^a ±0.17	11.68 ^b ±0.55	11.86 ^b ±0.17	*
TDN	55.17 ^b ±1.29	58.9 ^a ±0.65	57.98 ^a ±0.74	58.59 ^a ±1.06	NS

^{a, b, c} Means within the same row with different superscripts are significantly different, Sig. =Significance, NFE = Nitrogen free extract
NS=Non Significant, * (P≤0.05), ** (P≤0.01)

Table (5): Effect of feeding different levels of dried tomato pomace (DTP) on carcass traits of growing rabbits.

Item	Control	15%DTP	30%DTP	45%DTP	Sig.
Dressing percentage	62.09 ^{ab} ±1.91	64.47 ^a ±1.01	65.59 ^a ±0.93	59.16 ^b ±0.25	*
Hot carcass weight %	51.29 ^{ab} ±2.18	54.02 ^a ±1.19	56.08 ^a ±0.87	48.60 ^b ±0.77	*
Giblets weight %	4.35 ^a ±0.12	4.08 ^{ab} ±0.20	3.41 ^c ±0.05	3.85 ^b ±0.21	**
Heart weight %	0.32±0.03	0.30±0.02	0.29±0.02	0.34±0.06	NS
Liver weight %	3.35 ^a ±0.15	3.05 ^{ab} ±0.18	2.44 ^c ±0.04	2.76 ^{bc} ±0.16	**
Kidneys weight %	0.62±0.05	0.66±0.04	0.62±0.05	0.61±0.05	NS
Skin weight %	10.39±0.23	10.45±0.35	10.28±1.15	10.55±0.59	NS
Blood weight %	3.22±0.50	3.66±0.38	3.87±0.57	4.73±0.24	NS
Head weight %	6.45±0.25	6.37±0.24	6.10±0.22	6.47±0.29	NS
Total non carcass fat %	1.30±0.17	1.70±0.39	1.83±0.18	1.51±0.77	NS

^{a, b} Means within the same row with different superscripts are significantly different, Sig. =Significance
NS=Non Significant. * (P≤0.05), ** (P≤0.01)

control diet compared with those fed 30.0% and 45.0% DTP while there were no significant differences when compared with 15.0% DTP. There were no significant differences between different groups in other carcass characteristic values. These results are in agreement with those reported by Sawal et al (1996) and Abd El-Razik (1996) who found that carcass weight and dressing percentage were not affected by DTP levels.

Blood components:

Results in Table (6) showed no significant effects of dietary DTP levels on total plasma proteins, albumin, globulin, A/G ratio and urea-N concentration compared with control group.

These results were in agreement with those reported by Abd El-Razik (1996) and Belibasakis *et al.* (1995) who found that there were no differences in blood plasma concentrations of total protein and urea-N. Total plasma cholesterol was significantly reduced by feeding rabbit diets containing DTP up to 30.0% compared with those fed either control or 45.0% DTP diets. On the other hand, rabbits fed diet contained 45% DTP recorded higher value for total plasma lipids compared with both DTP groups and control group. The decrease of plasma cholesterol and lipids in groups fed DTP up to 30% may be due to its high fiber content, particularly cellulose and lignin. These results agree with Akiba and Matsunoto (1978) who reported that, the total bile acids excretion was slightly increased with increasing cellulose levels in the diets and the dietary fibers such as pectin and lignin, bran and alfalfa bind with bile

acids and result in a depression of blood cholesterol, increase bile acids excretion and mal-absorption of cholesterol and lipids.. Also, Shen et al (1998) showed that, dietary fiber level can partly inhibit hydroxy methyl glutaryl coenzyme A (HMG-COA), which is responsible for synthesis of cholesterol in the body. Furthermore, Tom Brody (1999) showed that, fiber may reduces plasma cholesterol, since it decrease the rate of passage of material through the upper gastro-intestinal tract and tend to delay the rate of absorption of nutrients, probably because of their ability to form viscous solution.

The results of cholesterol were in agreement with Kavitha et al (2007) who found that, blood cholesterol and LDL-cholesterol contents in broilers significantly decreased by DTP inclusion at 10 and 15% level in the diets. Liver enzyme activities (AST and ALT) were significantly reduced in groups fed either 15 or 30% DTP than those fed control and 45% DTP diets. It is worthy to confirm that plasma concentrations of both AST and ALT were within normal ranges suggested by Hillyer and Quesenberry (1994).

Economic evaluation:

It is clear that using DTP in the diet of the rabbits significantly ($P \leq 0.05$) improved the percent of economic efficiency expressed as % of net return/feed cost, relative economic efficiency and performance index than those received control diet (Table, 7). This improvement in economical evaluation in groups fed 15 and 30% DTP may be due to the improvement in body weight and feed conversion ratio. The high economic evaluation in 45% DTP group may be due to lower feed

Table (6): Effect of feeding different levels of dried tomato pomace (DTP) on blood constituents of growing rabbits.

Parameter	Control	15%DTP	30%DTP	45%DTP	Sig.
Total proteins (g/dl)	7.51±0.52	8.50±0.14	7.59±0.20	7.37±0.24	NS
Albumin (g/dl)	4.57±0.46	4.92±0.29	4.53±0.17	4.02±0.05	NS
Globulin (g/dl)	2.94±0.29	3.58±0.38	3.06±0.17	3.35±0.22	NS
A / G ratio	1.61±0.23	1.45±0.23	1.50±0.13	1.21±0.08	NS
Cholesterol (mg/dl)	144.6 ^a ±5.6	101.9 ^b ±10.8	96.4 ^b ±16.4	164.5 ^a ±4.5	**
Total Lipids (mg/dl)	394.3 ^{ab} ±31.7	278.3 ^b ±92.8	329.9 ^b ±41.3	504.4 ^a ±31.3	*
ALT (μ/l)	11.55 ^a ±1.2	6.63 ^b ±1.15	5.00 ^b ±0.71	7.77 ^b ±0.15	**
AST (μ/l)	23.1 ^{ab} ±0.2	14.5 ^{bc} ±1.5	11.5±1.5	31.5 ^a ±4.5	**
Urea-N (mg/dl)	31.77±0.81	33.05±3.04	28.13±1.01	28.64±1.22	NS

^{a, b, c} Means within the same row with different superscripts are significantly different at P=0.05. Sig. =Significance

NS = Not significant * (P≤0.05) ** (P≤0.01)

Table (7): Effect of feeding different levels of dried tomato pomace (DTP) on economic traits of growing rabbits.

Item	Control	15%DTP	30%DTP	45% DTP	Sig.
Total feed intake (Kg/rabbit)	4.98 ^b ±0.10	5.62 ^a ±0.14	5.47 ^{ab} ±0.10	4.27 ^c ±0.26	**
Live body weight	1.90 ^c ±0.02	2.21 ^a ±0.01	2.06 ^b ±0.03	1.87 ^c ±0.02	**
Total feed cost (LE)	7.47 ^a ±0.14	8.02 ^a ±0.10	7.23 ^a ±0.49	5.01 ^b ±0.31	**
Total return (LE) ¹	28.55 ^c ±0.33	33.28 ^a ±0.13	31.01 ^b ±0.51	28.09 ^c ±0.36	**
Net return (LE) ²	9.08 ^d ±0.18	13.26 ^a ±0.14	11.78 ^b ±0.07	11.08 ^c ±0.07	**
Economic efficiency (%)	121.4 ^c ±0.3	165.5 ^b ±3.2	164.7 ^b ±12.1	222.8 ^a ±13.4	**
Performance index	48.78 ^c ±0.32	62.96 ^a ±1.46	54.52 ^b ±1.50	54.93 ^b ±2.26	**

^{a, b} Means within the same row with different superscripts are significantly different, Sig. =Significance NS=Non Significant, * (P≤0.05), ** (P≤0.01) ¹ Based upon the price of 1 Kg live weight = 15.0 L.E. at time of experiment.

² Net return = Total return – [Total feed cost+ Fixed cost (12.0 L.E.)]

cost compared with the other groups. These results agreed with Abd El-Razik (1996) and Devasena et al (2007) who found that there was reduced cost per weight gain in the rabbits fed DTP containing diet up to 15% as compared to rabbits fed with control diet.

In conclusion, the results indicated that dried tomato pomace can be used up to 30% in growing rabbit diets as a substitute to high price conventional feed ingredients without adverse effects on productive performance, nutrients digestibility coefficients and blood components with improving economic efficiency.

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تأثير استخدام تفل الطماطم المجفف في علائق الارانب النامية

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استخدم في هذه الدراسة عدد ستون أرنب من النيوزيلندي الأبيض مقطوم على عمر خمسة أسابيع بمتوسط وزن مبدئي 625.8 ± 15.5 جم وذلك لدراسة تأثير استخدام مستويات مختلفة من تفل الطماطم المجفف على أداء النمو، معاملات الهضم، مقاييس الدم، خصائص الذبيحة و اقتصاديات الإنتاج. وزعت الارانب عشوائيا على اربع مجموعات تجريبية تتكون كل منها من خمسة عشر أرنباً في خمس تكرارات بكل منهم ثلاث حيوانات. غذيت المجموعة الأولى على الطليق الكنترول بدون اضافة تفل الطماطم المجفف، في حين غذيت المجموعة الثانية، الثالثة والرابعة على علائق محتوية على 15، 30، و 45% تفل الطماطم المجفف، على الترتيب. اوضحت النتائج أن استخدام تفل الطماطم المجفف حتى مستوى 30% اعطى زيادة معنوية في وزن الجسم والوزن المكتسب اليومي وذلك بالمقارنة بالمجموعة الكنترول أو 45% تفل الطماطم المجفف عند عمر 9 و 13 أسبوع. في حين أن المجموعة المغذاة على 15% تفل الطماطم المجفف سجلت أعلى معدل في وزن الجسم والوزن المكتسب اليومي خلال الفترة التجريبية كلها. لم يتأثر كل من المستهلك اليومي من العلف و معامل التحويل الغذائي باستخدام تفل الطماطم المجفف حتى مستوى 30% في حين سجلت المجموعة المغذاة على 45% تفل الطماطم المجفف أفضل معامل تحويل غذائي و أقل علف مستهلك يومي عند مقارنتها بالكنترول في نهاية الفترة التجريبية. أدى استخدام تفل الطماطم المجفف إلى جميع المعاملات التي تحسن في معاملات هضم المادة الجافة، المادة العضوية، البروتين الخام و المستخلص الخالي من النيتروجين وذلك عند مقارنتهم بالمجموعة الكنترول في حين انه لم تتأثر معاملات هضم المستخلص الايثيري معنويا. على نفس المنوال، سجلت قيم البروتين الخام المهضوم و المركبات المهضومة الكلية أعلى معدلاتها في المجموعات المغذاة على تفل الطماطم المجفف بالمقارنة بالمجموعة الكنترول. لم تظهر أي فروق معنوية في قيم التصافي والأوزان النسبية للذبيحة بين المجموعات المختلفة بما فيها مجموعة الكنترول في حين سجلت الأوزان النسبية للكبد والحوانج معدلات أعلى نسبيا مع المجموعة المغذاة على الطليقة الكنترول عند مقارنتها بالمجموعة المغذاة على 30% أو 45% تفل الطماطم المجفف. اوضحت النتائج عدم وجود فروق معنوية في قيم البروتينات الكلية، الألبومين، الجلوبيولين، نسبة الألبومين الى الجلوبيولين و اليوريا في بلازما الدم وذلك في المعاملات المغذاة على مستويات مختلفة من تفل الطماطم المجفف عند مقارنتها بالكنترول. انخفضت قيم الكوليسترول في البلازما معنويا عند تغذية الارانب على علائق محتوية على تفل الطماطم المجفف حتى معدل 30%. على النقيض، سجلت الارانب المغذاة على 45% تفل الطماطم المجفف أعلى معدلات الليبيدات الكلية في البلازما عند مقارنتها بالمجموعات 0، 15 و 30% تفل الطماطم المجفف. انخفض نشاط انزيمات الكبد معنويا في المجموعات المغذاة على 15% أو 30% تفل الطماطم المجفف عن نظيراتها في المجموعات المغذاة على الطليقة الكنترول أو 45% تفل الطماطم المجفف. أدى استخدام تفل الطماطم المجفف في علائق الارانب الى تحسين معنوي في الكفاءة الاقتصادية النسبية و دليل الأداء بالمقارنة بالمجموعة الكنترول. نستخلص من النتائج أن استخدام تفل الطماطم المجفف حتى معدل 30% في علائق الارانب النامية يمكن أن يحسن الأداء الإنتاجي، معاملات الهضم، مكونات الدم والكفاءة الاقتصادية.