Evaluation of Dried Tomato Pomace as Feedstuff in the Diets of Growing Rabbits

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Abstract

This study was conducted to investigate the growth performance, digestibility, carcass traits, blood biochemical parameters and economical efficiency of rabbits fed on different levels of dried tomato pomace 10, 20 & 30%. Twenty four of New Zealand White rabbits of averaged 945 g body weight (6 weeks of age) were divided into four groups, of six each. The first group was fed a basal diet without dried tomato pomace and considered as control, while the other three groups were fed the basal diet after substituting part of the diet with dried tomato pomace at 10, 20 & 30%, respectively. There was significant ($P<0.05$) difference between different experimental groups in live body weight and weight gains and feed intake. There were no significant differences in the dry matter, crude protein and nitrogen free-extract digestibilities, while there were significant differences ($P<0.05$) in the ether extract and crude fibre digestibility between different experimental groups and the diet contained 20% dried tomato pomace recorded the highest values compared to other treated groups. There was significant ($P<0.05$) difference between different experimental groups in dressing percentages, while no significant differences in weight percentages of liver, kidneys, heart and lungs.

It could be concluded that dried tomato pomace can be utilized efficiently and safely in the diets of rabbits up to level of 20% without any adverse effect on the performance and carcass traits.

Key words: dried tomato pomace, feedstuff, rabbits

Introduction

The shortage of raw materials such as corn, soybean for the rabbit feed industry has resulted in a continuous increase in the cost of production, causing a phenomenal rise in the unit cost of product. Thus these products have become too expensive for the majority population. In developing countries in particular increases in population practically erodes increase in food production leaving no hope of ever having surplus grains to compound economically viable livestock feeds [7, 18]. The processing of many fruit and vegetable products generate wastes which could contribute to environmental pollution. The tomato processing serves as an excellent example. The total waste produced from tomatoes from world production was estimated roughly to be 3.70 million ton/year [11]. Tomato pomace is a mixture of tomato skin, pulp and crushed seeds that remain after the processing of tomato for juice, paste and/or ketchup [17]. This by product remains from squeeze of tomato is rich in protein, energy and crude fibre. In addition, it contains more essential amino acids for rabbits as compared to alfalfa meal of good quality [3]. Bordowski and Geisman [5] reported that tomato seeds protein contain approximately 13% more lysine than soy protein, which would allow it to be used in fortifying low lysine foods. Elloitt et al. [10] demonstrated that tomato pomace is a good source of protein but may be limited in energy due to the high fiber content.

The present study was conducted to investigate the growth performance, digestibility, carcass traits and economical efficiency of rabbits fed on different levels of tomato pomace.

Materials and methods

The present study was designed to evaluate the effect of different levels of dried tomato pomace (DTP) (0, 10, 20, 30%) of complete diets as a non-conventional ingredients on growth performance, digestibility, carcass traits, and economical efficiency of growing rabbits. The feeding trial was carried out for 8 weeks.

Tomato pomace (TP) preparation:

The TP consists mainly of skins, seeds and hard tissues of the whole tomatoes. The TP was air dried, ground and thoroughly mixed, then samples were taken for proximate chemical analysis.

Experimental diets:

The experimental diets were prepared by thoroughly mixed the ingredients which composed of yellow corn, soybean meal, wheat bran, berseem hay, molasses and DTP. Four experimental diets were formulated to satisfy the nutrient requirements of growing rabbits according to NRC [16] and were pelleted. The first group was fed a basal diet (0% DTP) and considered as control, while the other three groups were fed the basal diet after substituting part of the diet with DTP at 10, 20 & 30% respectively (table 1).

Table 1. Composition of the experimental diets

Ingredients	Diets			
	Control	10% DTP [1]	20% DTP	30% DTP
Physical composition:				
Corn, ground	31.95	20.00	27.00	26.75
Soybean meal	11.50	6.00	5.00	2.20
Wheat bran	11.50	20.85	10.50	5.00
Berseem hay	39.00	37.60	31.05	30.00
Tomato pomace (DTP)	0.00	10.00	20.00	30.00
Molasses	5.00	5.00	5.00	5.00
Common salt	0.50	0.50	0.50	0.50
Methionine	0.25	0.25	0.25	0.25
Premix [2]	0.30	0.30	0.30	0.30
Chemical composition:				
Dry matter	87.80	87.87	88.12	88.32
Crude protein	16.00	16.00	16.00	16.00
DE (Kcal/kg diet) [3]	2669	2617	2686	2669
Crude fibre	13.04	15.70	16.05	17.80
Ether extract	7.80	8.20	7.08	6.71
Nitrogen free-extract	54.57	50.70	50.80	48.90
Calcium	0.59	0.61	0.55	0.56
Total phosphorus	0.35	0.51	0.43	0.39

[1]DTP = Dried tomato pomace [3]DE- Digestible energy (Kcal/kg diet) provided by calculation

[2] Egavet premix: Each 3 kg contain: vitamin A, 12.000.000 IU; vitamin D, 2.500.000 IU; vitamin E, 10.000 mg; vitamin K3, 1000 mg; vitamin B1, 1000 mg; vitamin B2, 5000 mg; vitamin B6, 1500 mg; niacin, 30.000 mg; biotin, 50 mg; folic acid, 1000 mg; pantothenic acid, 10.000 mg; Mn, 60.000 mg; Zn, 50.000 mg; Fe, 30.000 mg; Cu, 5.000 mg; Se, 100 mg; Co, 100 mg; Mn, 250.000 mg; CaCo3, up to 3kg.

Animals, housing & feeding:

Twenty four of New Zealand White rabbits of averaged 945 g body weight (6 weeks of age) were divided into four groups, of six each. Each treatment was assigned to one of four dietary treatments: 0, 10, 20 and 30% dried Tomato pomace, DTP). All rabbits were housed individually in galvanized wire cages that allowed separation of feces and urine. Rabbits were kept under standard hygienic conditions and were subjected to a prophylactic vaccination and pharmacological program against viral and bacterial diseases. All the experimental rabbits were fed on the experimental diets ad-libitum. Fresh and clean water as available all time. Feed intake was recorded weekly during the experimental period. Rabbits were individually weighed before offering morning meal every week. The following parameters were recorded or calculated; body weight, daily weight gain, feed intake, feed conversion, feed efficiency and economical efficiency.

Digestibility trials:

The daily fecal matter excreted from each animal was collected during the collection period (last 5 days of the experiment) to plastic bags then weighed, sampled, mixed, dried at 60 °C, ground and stored to be analyzed for different nutrients. From the analysis of the diets and fecal matter excreted, the digestion coefficient of dry matter and other nutrients were calculated according to the following equation [15]:

$$\text{D.C of any nutrient} = \frac{\text{Amount of nutrient intake} - \text{amount of nutrient in feces}}{\text{Amount of nutrient intake}} \times 100$$

Carcass traits & blood samples:

At the end of the experiment, three rabbits from each group were weighed then slaughtered after fasting 12 hours [14]. After complete bleeding (within 30 minutes), pelts, viscera and tail were removed. The eviscerated carcass was weighed and the dressing percentage was calculated.

Chemical analysis:

The feed ingredients used, experimental diets and feces collected were sampled, dried, ground, mixed thoroughly and analyzed for determination of different nutrients according to the methods of AOAC [1].

Economical efficiency:

Economical efficiency was calculated as the ratio between income (price of weight gain) and the cost of feed consumed.

Statistical analysis:

All data were subjected to one-way analysis of variance (ANOVA) using the lines model of Statistical Analysis System [20], and differences ($P<0.05$) among treatments were tested using Duncan's multiple test [9].

Results

Results showed that there was significant difference ($P<0.05$) between the experimental groups in the live body weight, weight gain and feed intake (table 2). Dried tomato pomace recorded the highest values in weight gain, feed intake and feed conversion up to 20% (20.70 g, 74.30 g, 3.59, respectively) then decreased at highest level of 30% DTP (15.11 g, 70.85 g, 4.69). The 20% DTP gave the highest values in the digestion coefficients of ether extract (78.10%) and crude fibre (35.10%) compared to other treatment groups (65.15-75.92%, 18.85-24.13%, respectively), while the digestion coefficient of other nutrients (dry matter, crude protein and nitrogen free-extract) were not affected (table 3). Lowest values in dressed carcass (880.17 g) and dressing % (50.91%) were found with the highest level of DTP (30%) compared to other experimental groups (1109.66-1156.26 g, 55.75-57.60%, respectively), while heart, kidneys, liver and lungs were not affected by the treatments (table 4). The rabbits group fed on 20%DTP was obtained the highest net revenue (15.02 LE) and economical feed efficiency (133.16%) compared to other treated groups (table 5).

Table 2. Performance of growing rabbits fed different levels of dried tomato pomace

Items	Groups			
	Control	10% DTP	20% DTP	30% DTP
Initial body weight (g)	940±29.8	942±30.4	945±25.3	943±20.5
Final body weight (g)	2003±40.6 [a 1]	1986±38.6 [a]	2104±45.2 [a]	1789±41.5 [b]
Total weight gain (g)	1063±35.2 [a]	1044±33.6 [a]	1159±37.6 [a]	846±30.3 [b]
Daily weight gain (g)	18.50±0.50 [a]	18.65±0.80 [a]	20.70±0.76 [a]	15.11±0.39 [b]
Daily feed intake (g)	77.88±1.75 [a]	75.90±1.90 [a]	74.30±2.01 [a]	70.85±1.50 [b]
Feed conversion	4.21±0.27 [a]	4.07±0.22 [a]	3.59±0.28 [a]	4.69±0.31 [b]
Growth rate %	113.09	110.83	122.65	89.71

[1] Figures in the same row having the same superscripts are not significantly different (P<0.05)

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

Items	Diets			
	Control	10% DTP	20% DTP	30% DTP
Nutrient digestibility				
Dry matter	79.13±1.50	76.25±1.42	80.20±1.70	78.15±1.35
Crude protein	75.60±1.36	75.01±1.25	72.20±1.36	70.35±1.28
Ether extract	70.42±1.68 [b 1]	75.92±1.63 [ab]	78.10±1.30 [a]	65.15±1.90 [b]
Crude fibre	19.80±1.70 [b]	24.13±1.90 [b]	35.10±1.60 [a]	18.85±1.42 [b]
Nitrogen free extract	78.18±1.50	76.40±1.74	78.50±1.20	79.01±1.49
Feeding values:				
TDN (%) [2]	69.69±1.30 [a]	68.54±1.50 [a]	69.50±1.25 [a]	63.09±1.40 [b]
Digestible protein (%)	12.10±0.55	12.00±0.75	11.55±0.65	11.26±0.70

[1] Figures in the same row having the same superscripts are not significantly different (P<0.05)

[2] TDN – Total digestible nutrients

Table 4. Carcass traits of growing fed different levels of dried tomato pomace

Items	Groups			
	Control	10% DTP	20% DTP	30% DTP
No of rabbits	3	3	3	3
Pre-slaughter weight (g)	1978±35.12	1968±29.80	2074±32.60	1729±30.25
Dressed carcass weight (g)	1109.66±25.80 [a]	1133.57±29.30 [a]	1156.26±30.01 [a]	880.17±29.10 [b]
Dressing (%)	56.10±0.84 [a]	57.60±0.75 [a]	55.75±0.55 [a]	50.91±0.60 [b]
Heart (%)	0.37±0.04	0.28±0.01	0.34±0.03	0.31±0.01
Kidneys (%)	0.63±0.03	0.65±0.04	0.73±0.05	0.64±0.02
Liver (%)	2.56±0.15	3.10±0.18	3.01±0.25	2.30±0.10
Lungs (%)	0.70±0.02	0.75±0.03	0.65±0.01	0.73±0.04

[1] Figures in the same row having the same superscripts are not significantly different (P<0.05)

Table 5. Economical evaluation of the different experimental groups

Items	Groups			
	Control	10%DTP	20% DTP	30% DTP
Total feed cost	6.89	5.87	5.28	4.64
Total production cost	12.89	11.87	11.28	10.64
Body weight (g/rabbit)	2003	1986	2104	1789
Price of body weight (L.E) [1]	25.04	24.83	26.30	22.36
Net revenue (L.E)	12.15	12.96	15.02	11.72
Economic feed efficiency (%)	94.26	109.18	133.16	110.15
Relative economic feed efficiency (%)	100	115.83	141.27	116.86

[1] L.E- Egyptian pound

Discussion

Rabbits fed the diets contained 20% DTP recorded the highest average body weight, while rabbits fed 30% DTP diet showed the lowest values of live body weight. These results were agreed with that found by Kavamoto et al. [13] who reported that body weight of rabbits was higher with 21% level of DTP. Ahmed et al. [3] found no significant differences in live weight between rabbits groups fed diets contained 10, 20 & 30% DTP as a substitution for alfalfa. Data of the present study indicated that rabbits fed the diet contained 20% DTP recorded almost higher daily gains, while rabbits fed on the 30% DTP level recorded the lowest value of daily gain. These results are in agreement with that found by Alicata et al. [4] who reported that 20% DTP replacing dried Lucerne meal in the diet of rabbits increased weight gain. On contrary, Rojas et al. [19] and Ahmed et al. [3] showed no significant differences in weight gain among the groups of rabbits fed diets with or without 10% or 30% dried tomato pomace. Rabbits fed the diet contained 30% DTP level were consumed the lowest amount of feed, while rabbits fed the diet contained 0% DTP (control diet) consumed the highest amount of feed. These results were agreed with that found by Ahmed et al. [3] who reported that the daily feed intake of rabbits fed on diet contained 30% DTP was lower than other treated groups and this may be due to the effect of fat content of DTP. In addition, Caro et al.[6] found that average daily intake of meat rabbits was significantly affected by diets with 30% of tomato pomace, decreasing 21% in relation to the control group. Sawal et al. [21] stated that the incorporation of TP at levels of 0, 10 & 20% in the diet of rabbits increased ($P<0.05$) feed intake. Rabbits fed the diet contained 20% DTP level recorded the best feed conversion compared to other treated groups. These results are in agreement with those reported by Alicata et al. [4] and Ahmed et al. [3] they reported that incorporation of TP in the diet of rabbits up to 20% improved feed conversion. Sawal et al. [21] noticed that feed conversion was decreased with increasing dried tomato pomace in rabbit diets.

There were no significant differences in the dry matter, crude protein and nitrogen free-extract digestibilities between different experimental groups. There were a significant differences ($P<0.05$) between different experimental groups of rabbits in the ether extract and crude fibre digestibility and the diet contained 20% DTP recorded the highest values compared to other treated groups. These results were agreed with that found by Alicate et al.[4] and Sawal et al. [21] who reported that inclusion of 20% TP in rabbit diet was increased the digestibility coefficients of all nutrients specially crude fibre & ether extract digestibilities. Devasena et al. [8] found that TP up to 15% in the rabbit diets had no significant difference for dry matter, organic matter, crude protein, nitrogen free-extract, however were significant ($P<0.05$) for crude fibre and ether extract. In addition, Gippert et al. [12] reported that substitution of 10% and 20% alfalfa meal with TP was increased the utilization of nutrients in rabbits.

The diet contained the 30% DTP had the lowest total digestible nutrients and digestible crude protein, while other treatment had the same nutritive values nearly as control one. The total digestible nutrients and digestible crude protein of 10% & 20% DTP diets were higher than that of 30% DTP. Ahmed et al. [3] found that the total digestible nutrients value of 10% TP diet was significantly ($P<0.05$) higher than that of in 30% dried tomato pomace ones.

There was significant ($P<0.05$) difference between different experimental groups in dressing percentages and the group fed on 30%DTP recorded the lowest values. There was no significant differences in the weight percentages of liver, kidneys, heart and lungs. These results are agreed with that reported by Kavamoto et al. [13] who concluded that carcass yield was best with tomato meal at replacing level of 21% in rabbit nutrition. Abd El-Razik [2] revealed that carcass weight and dressing percentage values of rabbits did not differ significantly among group fed the experimental diets containing 0, 5 & 10% dried tomato pomace.

Results obtained indicated that substitution of 20% DTP of the diet was increased the net revenue and economic efficiency to 141.27% compared to the control diet.

The result obtained in this study showed that the dried tomato pomace can be substituted in the diets of rabbits up to 20% without any adverse effect on the performance and carcass traits beside it have an economical value.

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