Effect of Using Dried Citrus Pulp Instead of Maize in Pelleted Diets on Rabbit Performance

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Abstract: Forty growing New Zealand White (NZW) rabbits aged six weeks and averaged 647.25 g body weight, were used in the present study. Animals were allotted to four experimental groups (10 animals in each) with nearly equal average body weights, and were given four pelleted complete diets contained 0, 6.3, 12.5 and 18.7% dried citrus pulp in place of 0, 25, 50 and 75%, respectively, of the maize in the control diet. The four diets contained 17.36, 17.38, 17.39 and 17.40 % crude protein were formulated to meet or exceed the essential nutrient requirements of a mixed feed for growing rabbits. The study was carried out for 8 weeks. The traits studied were growth performance, nutrients digestibility, ceacum activity, carcass treats, blood constituents and economic efficiency. The results showed that dry matter intake was insignificantly different among all groups, indicating the palatability may improved by offering dried citrus pulp at different levels for rabbits. Diet contained 12.5% (50% substitution) and 18.7% (75% substitution) dried citrus pulp had slightly higher in most nutrients digestibility, acidity, and TVFA. Also, the results indicated that dressing percentage (DP%) values and biochemical analysis of blood plasma were not significantly changed in rabbit groups consumed citrus pulp. Therefore, rabbit fed on diets containing dried citrus pulp had the best economical efficiency compared to the control diet. Results of the study indicate that dried citrus pulp is a good source of energy and can be included in the diet of growing rabbits up to 18.7% to replace 75% of maize without adversely effects on growth performance, nutrients utilization, ceacum activity, carcass treats and blood constituents.

Keywords: dried citrus pulp; Growth performance; Digestibility; Ceacum activity, Carcass treats: Rabbits.

INTRODUCTION

The problem of animal feed scarcity in Egypt and other developing countries has attained a deplorable status which calls for urgent remedy. This problem has been blamed on high cost of conventional ingredients for feed making which has made animal feed major cost of production (Agbakoba *et al.,* 1995). Madubuike and Ekenyem (2001); Faniyi (2002) had rated feeds as constituting 70 – 80% of the cost of animal production, of which maize constitutes major costs. However, sub optimal production of the pulses and cereals, giving rise to stiff competition between man and his livestock for the crop products, (Tegbe *et al.,* 1984, Madubuike, 1992; Akinfola and Tewe, 2002;). Moreover, trend to use cereals in ethanol fuel production. Therefore alternatives must be found.

Many studies have shown that it is possible to substitute all or part of cereals in animal feeding by various by-products having a high energetic value. The energy value of these is generally not far from that of cereals (rice, oat, and barley) making them a good substitute for cereals (Hall, 2002). However, citrus pulp is an energy-rich with high metabolisable energy content and could be used as a source of energy in ruminant, although feeding high moisture content of citrus pulp may limit consumption of the diet and difficult to store (Wing, *1982;* Kayouli and Lee, *1999* and Scerra *et al.,* 2001).

The objective of this trial is to evaluate growth performance, nutrient digestibility and nutritive value of diets contained different level of dried citrus pulp fed to growing rabbits with a view to ascertaining its potentials for reducing the cost of animal production in Egypt.

MATERIALS AND METHODS

The present experiment was conducted in the Rabbitry Research Farm, College of Agriculture, Suez Canal University, Ismailia, Egypt.

Forty New Zealand White rabbits, six weeks old, and averaged 647.25±4.16 g body weight were used in a growth study to evaluate quality substitution of maize in the rabbit diets partially by dried citrus pulp for 8 weeks. The citrus pulp (mixture of orange peel, pulp and seeds) was obtained fresh from a local citrus canning factory of Ismailia Governorate and dried at 60°C for at least 24 h in a forced-air oven. The dried citrus pulp was ground and thoroughly mixed. Chemical analysis of the maize and citrus pulp are presented in Table (1).

Table (1): Chemical composition of Maize and citrus pulp

Items	% Chemical composition						
	DM	OM	CP	CF	EE	NFE	ASH
Maize							
As fed	90.32	89.01	8.54	2.94	4.70	72.84	1.31
DM basis	100	98.55	9.45	3.25	5.2	80.65	1.45
Citrus pulp							
On fresh basis	20.15	19.26	1.75	1.94	2.65	12.92	0.89
DM basis	100	95.58	8.68	9.64	13.14	64.12	4.42

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Animals:

Forty male New Zealand White rabbits (NZW) at six weeks of age were divided into 4 equal groups according to initial live body weight, LBW (10 rabbits per group) Rabbits of each group were randomly distributed assigned to receive one of the four experimental diets, representing four treatments, T1 (0% dried citrus pulp), T2 (6.3% dried citrus pulp), T3 (12.5% dried citrus pulp) and T4 (18.7% dried citrus pulp) to replace maize at level of 0, 25, 50 and 75 %, form maize diet by weight, respectively.

Experimental Diets:

The experimental diets were prepared by thoroughly mixing the ingredients which composed of maize, wheat bran, Sun flower meal, Soya bean meal, clover hay, dried citrus pulp, and molasses. Four experimental diets were formulated to satisfy recommended nutrient requirements of growing rabbits according to NRC (1977) and Cheek (1987). Diets were pelleted in, rabbit's diet factory, Sharkya Governorate. The 1st experimental diet had served as control (0% dried citrus pulp) and the other three treatment diets contained dried citrus pulp at levels of 6.3, 12.5 and 18.7% of the diet in groups 2, 3 and 4, respectively. The composition and chemical analysis of the experimental diets are presented in Table (2).

Housing, Management and Feeding:

Rabbits were housed in individual hutches arranged in two rows of the rabbitry that has a concrete floor. It was designed to ensure cross ventilation and to protect the rabbits from rodents and other pests. Each rabbit was provided with a metallic feeder hanged at a reasonable height in the cage to prevent feed wastage. All rabbits were kept under the same managerial, hygienic and environmental conditions. Rations were offered to the rabbits *ad libitum* and fresh water was automatically available all the time by stainless steel nipples for each cage 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 (g feed/g gain) rate and economical efficiency.

Digestibility Trail:

At the end of the experimental (feeding) period (14 weeks), a digestibility trail was performed to determine the digestibility coefficients of the experimental diets.

A total number of 20 male rabbits (5 within each treatment, 3 of them with coller to prevent coprophagy and 2 without coller) were allotted to meet the different treatments. Rabbits were housed individually in metabolic cages that allow collecting feces and urine throughout the digestibility trial. Quantitative collection of feces was started 24 hrs after offering the daily feed. Feces of each male were collected and feed intake was recorded every day in the morning for a collecting period of 5 days. The same feeding regimes used during the feeding trial were also followed through the digestibility trial. Fecal samples were sprayed with 10% sulphuric acid and toluene and dried at 60°C until constant weight. Finally, collected feces for each male of each treatment were mixed, ground and stored for chemical analysis. Composite samples of daily urine (containing 10% H_2SO_4 solution) were collected for each animal over the collection period for nitrogen determination. Proximate analysis of the diets, feces and urine nitrogen were carried out according to the methods of AOAC (1990).

Table (2): Percentage composition and proximate analysis of the experimental diets

Ingredients %	Level of dried citrus pulp replacement (%)			
	0	25	50	75
Maize	25	18.7	12.5	6.3
Wheat bran	26	26	26	26
Sun flower meal	10	10	10	10
Soya bean meal	10	10	10	10
Clover hay	25	25	25	25
Dried citrus pulp	0	6.3	12.5	18.7
Methionine	0.3	0.3	0.3	0.3
Salt	0.5	0.5	0.5	0.5
Limestone	1	1	1	1
Molasses	1.9	1.9	1.9	1.9
Minerals and vitamin mix [a]	0.3	0.3	0.3	0.3
Proximate analysis, % of dry matter				
Crude protein	17.36	17.38	17.39	17.40
Crude fibre	12.41	12.75	13.09	13.42
Ether extract	3.71	4.28	4.85	5.41
Nitrogen free extract	60.57	59.46	58.36	57.26
Ash	5.95	6.13	6.32	6.50

[a] Composition of the mineral and vitamin mix per 1 kg: Vitamin A, 4,000,000 IU; Vitamin D3, 50,000 IU; Vitamin E, 16.79 g; Vitamin K, 0.67 g; Vitamin B1, 0.67 g: Vitamin B2, 2.0 g; Vitamin B6, 0.67 g; Vitamin B12, 0.004 g; Pantothenic acid, 6.67 g; Biotin 0.07g; Folic acid, 1.67 g; Choline chloride, 400g; Mn, 10 g; Zn, 23.3 g; Fe, 25 g; Ca, 1.67 g; I, 0.25 g: Se, 0.033 g; Mg [illegible]Mg.

Carcass Characteristics:

At the end of the feeding period (14 weeks), three rabbits from each dietary treatment were randomly chosen to study the carcass traits. Rabbits were fasting for approximately 16 hours, individually weighed (to record the fasting weights) and thereafter slaughtered by severing the neck with a sharp knife according to the Islamic method. The slaughtered weight (weight after complete bleeding) was recorded and instantly the head was separated. Skinning off was carried out by removing the skin including the tail and feet thereafter, the carcass was opened down and all entrails were removed. The lungs, liver, kidneys and heart were also removed and the rest of the body was weighed to determine the dressed weight.

Cecal trial:

Seven days after the last cecotrophy control, the animals were slaughtered by cervical dislocation at the time of 18:30, to avoid the cecotrophy period. The gastrointestinal tract was removed and weighed. The stomach and cecum were weighed separately with and without their contents. The pH was measured in the cecal contents. Cecal content was immediately divided into two samples; one was dried at 80 °C and used to determine buffer capacity. The other sample was centrifuged at 2500 rpm for 10 min. The supernatant fluid was used to determine ammonia nitrogen (NH_3-N) and total VFA's concentration. A solution of 5% orthophosphoric acid plus 1% mercury chloride was added (0.1 mL/mL) to the samples for total VFA's determination. Samples for ammonia nitrogen determination were acidified with a solution of 0.2 M hydrochloric acid. The fluid pH values were immediately determined by a digital pH-meter. NH_3-N concentration was determined according to Conway (1957). Total volatile fatty acids (VFA's) were determined by the steam distillation method as described by Warner (1964) and fraction values of VFA were determined using KNAUER HPLC Pump 64. UV. Detector, column Rezex.

Blood Constituents:

At the end of experimental period pooled blood samples were taken from all animals per each treatment to estimate serum protein, total lipids, and creatinine using reagent colorimetric methods., Aspartate aminotransferase (AST) and alanine aminotransferase (ALT), urea-N and albumin were also analyzed using assay kits supplied by Bio-Meriux (France) and Randox (England). The globulin values were obtained by subtracting albumin values from total protein values.

Economical efficiency *(Y)*:

At 14 weeks of age was calculated according to the following equation; [Y= {(A- B) / B} x 100], where A is the selling price of the obtained gain and B is the feeding cost of this gain.

Statistical analysis:

The Statistical Analysis Systems (SAS, 1999) were applied for all studied parameters the linear mathematical model for the analysis comprised the effect of treatment as the sole source of variation (One-way analysis of variance). Significant differences among means were evaluated using Duncan's Multiple Range Test (Duncan, 1955).

RESULTS AND DISCUSSION

Data in Table (1) illustrate chemical composition of dried citrus pulp of the present study. On DM basis. nitrogen free extract of dried citrus pulp was lower than that in maize (64.12 versus 80.65). While, crude fiber (9.64 versus 3.25), ether extract (13.14 versus 5.2) and ash (4.42 versus 1.45) were higher than that in maize. In general these values were within the range of the database used by Cheek *et al.*, (1982); Belibasakis and Tsirgogianni, (1996); Fegeros, *et al.* (1995); Lanza, (1982); Lanza *et al.* (2001) and Scerra, *et al.* (2001), they mentioned that Citrus pulp as a by-product derived from the citrus juice industry included a mixture of citrus peel, pulp and seeds had favourable nutritional characteristics such as a high energy content, a significant fiber content and high palatability, mainly are used in ruminant feeding.

Digestibility and nutritive values:

Apparent digestion coefficients values presented in Table 3 of dry matter (DM), organic matter (OM), crude protein (CP), ether extract (EE), crude fiber (CF) and nitrogen free extract (NFE) were not significant ($P<0.05$) and the data indicated that, all nutrient digestibilities values slightly increased with increased the level of dried citrus pulp in diets.

Concerning digestion coefficient of crude fiber CF, the data showed that T4 (75% substituted) was the best as reported by Cheeke *et al.* (1986) that, increase activity of rabbit caecum could be one of the reasons of high fiber digestibility and the amount of pectin depends on the type fiber given as reported by Juhr and Ratsch (1986). It seems that citrus pulp had no significant effect on CP, CF, DM, OM, EE and NFE digestibility values of T2, T3 and T4 compared to T1 and similar trend was observed for the feeding values of the tested diets in terms of digestible crude protein (DCP%) and metabolizable energy which had no significant effect ($P<0.05$). Results reported by (Gaillard, 1962; Hatfield and Weimer, 1995) indicated that, addition of citrus pulp in rabbit diet had a significant effect on improving digestibilities coefficient of nutrients.

Caecum activity:

caecum activity presented in Table 4 showed that, The pH values of caecal contents had no significant effect ($P<0.05$) but tended to be more acidic with increase the level of citrus pulp in the diets. These results are in agreement with Gaillard,(1962), who reported that, pH value was lower in high carbohydrates diets than low and Hatfield and Weimer, (1995) noticed that pH maintained at 5.15 may have altered bacterial populations that able to digest the pectic substances.

Concerning values of TVFA and acids percentages, also, there were no significant differences ($P<0.05$) as shown in Table 4, the highest values 64.9 and 64.6 mmol/l caecum juices were recorded for rabbits given T3 and T4 but the lowest value 62.2 mmol/l caecum was for rabbits given T1, these results were in agreement with Morisse *et al.* (1990) who found that,

indigestibility cellulose in rabbits diets decreased TVFA. Also, Cheeke *et al.* (1987) reported that low cellulose activity of the rabbit caecum could be one of the reasons of low fiber digestibility. Concentrations of individual VFA as shown in Table 4 were insignificantly differed (P<0.05), these differences may be due to many factors, the rate of production of this acid, the rate of its absorption, the rate of its utilization, the rate of its utilization by cacum or rumen microorganisms and finally to its conversion to other rumen or caecum metabolites as reported by Gray and Pilgim (1951).Whatever The molar concentration of acetate was greater for the dried citrus pulp treatment, whereas propionate was lower. These results agree with those of Marounek *et al.* (1985), who found approximately 84 to 95% of the total production of VFA as acetate when purified pectin from citrus pulp was fermented in vitro compared with approximately 56 to 71% of VFA as acetate from starch. They also reported that the molar proportion for acetate was lowest with starch fermentation and highest with pectin fermentation. In the present study, the acetate: propionate ratio was lower for the control diet and greater for the diets contain dried citrus pulp. Marounek *et al.* (1985) reported a greater acetate: propionate ratio for fermentation of pectin than for starch. No difference was detected for butyrate concentration, which agrees with Ben-Ghedalia *et al.* (1989), who reported a similar concentration using dried citrus pulp compared with barley as a starch source.

consumed citrus pulp (Table 7). Also, total protein, albumin, and globulin were insignificantly changed due to treatment. Total protein level in plasma of rabbits consumed citrus pulp was slightly higher than that in the control group and in the meantime higher levels in AST and ALT enzymes in the treated groups. This could be due to increases of protein utilization and amino acids transamination in the treated groups. Urea and creatinine represent the two nitrogenous components that are eventually excreted by the kidney; therefore, changes in their levels in blood stream would reflect the insufficiency of kidney tubules or kidney malfunction.

Growth Performance:

Data in Table 5 showed that, dry mater intake, daily body gain and feed conversion of rabbit were not significantly differed (P<0.05) among treatments. Growth values improved by increasing dried citrus pulp in the diets where, rabbits fed maize diet had lower values of daily gain than supplemented with dried citrus pulp. Lanza, 1982 and Martillotti, *et al.,* 1996 reported that citrus pulp had improved live body weight and daily gain.

Carcass characteristics:

Data presented in Table 6 showed non significant differences (P<0.05) of dressing percentage (DP%) values. The percentage values of full caecum %, full stomach %, and caecum length which did not differ significantly (P<0.05) among treatments. Quantity of fiber and its kind may had an effect on the transit time of digesta as recorded in lambs by Biondi, *et al.* (1996), then the full weights of organs may be differed. Treatments showed non significant differences of head, heart, kidney and liver wt. %.

Blood biochemical parameters:

Biochemical analysis of blood plasma indicated that means of blood plasma glucose, urea and creatinine were not significantly changed in rabbit groups

Economic evaluation:

The price of diets was based on the price of ingredients in the Egyptian market during (2009) and the data in Table (8) showed that, the experimental diets had cheaper cost than control one. The results also showed the availability to use the previous commercial products without any raise in the cost of diets and the improve of the economic efficiency of these diets compared with control one, due to the improve of performance of rabbits fed diets contained citrus pulp as reported by Lanza, (1982), The best economic efficiency was for T4 followed by T3, T2 and T1 respectively.

Table (3): Effect of dried citrus pulp substitution treatments on nutrients digestibility and nutritive value.

Items	Level of dried citrus pulp replacement (%)			
	Group1 (T1) 0%	Group 2 (T2) 25%	Group 3 (T3) 50%	Group 4 (T4) 75%
Daily intake (g/head/day)				
Dry matter	95.71	97.24	99.54	100.36
Organic matter (A)	90.02	91.28	93.26	93.83
Digestibility coefficients				
Dry Matter	64.85±0.7	64.47±0.7	64.72±0.8	64.99±0.8
Organic matter (B)	65.61±0.8	65.91±0.8	65.32±0.9	66.72±0.9
Crude protein	70.75±0.9	71.22±0.9	72.66±0.7	71.96±0.7
Ether extract	64.75±0.9	65.82±0.9	65.45±0.8	64.81±0.8
Crude fiber	35.95±0.8	36.69±0.8	37.26±0.9	38.59±0.9
Nitrogen free extract	74.04±0.9	74.35±0.9	74.56±0.1	74.84±0.10
Digestible organic matter (A x B/100)	59.06	60.16	60.92	62.60
Digestible energy (MJ/kg DM)*	11.22	11.43	11.57	11.89
Metabolisable energy (MJ /kg DM)**	8.86	9.02	9.14	9.39
Digested crude protein	12.28	12.38	12.64	12.52

All means in the same row were not significantly different (P<0.05).

*Digestible Energy (MJ/kg DM) = 0.19xDigestible organic matter digestibility (DOMD) in g/100g.

** Metabolisable energy (MJ/kg DM) = 0.15 x DOMD (MAFF, 1975).

Table (4): Effect of dried citrus pulp substitution treatments on male rabbits caecum activity.

Items	Level of dried citrus pulp replacement (%)			
	Group1 (T1) 0%	Group 2 (T2) 25%	Group 3 (T3) 50%	Group 4 (T4) 75%
pH	5.72	5.33	5.45	5.15
TVFA's (mmol/l)	62.2	63.4	64.6	64.9
N-NH_3, (mmol/l)	18.2	17.9	18.4	19.3
Acetic acid (%)	40.04±0.44	45.39±0.04	45.60±0.99	48.92±0.18
Propionic acid (%)	30.95±0.74	30.47±0.93	31.10±0.83	27.68±0.64
Butyric acid (%)	19.47±0.56	18.92±0.86	21.46±0.54	20.76±0.52

All means in the same row were not significantly different (P<0.05).

Table (5): Effect of dried citrus pulp substitution treatments on male rabbits growth performance

	Level of dried citrus pulp replacement (%)			
	Group1 (T1) 0%	Group 2 (T2) 25%	Group 3 (T3) 50%	Group 4 (T4) 75%
DM intake (g/head/day)	105.21±2.3	107.85±2.4	109.47±2.5	110.37±2.5
Weight gain (g/head/day)	29.44±0.7	29.48±0.9	29.52±0.8	29.64±0.7
Feed conversion (g feed/ g gain)	3.57±0.2	3.66±0.3	3.71±0.2	3.72±0.1

All means in the same row were not significantly different (P<0.05).

Table (6): Effect of dried citrus pulp substitution treatments on carcass characteristics.

	Level of dried citrus pulp replacement (%)			
	Group1 (T1) 0%	Group 2 (T2) 25%	Group 3 (T3) 50%	Group 4 (T4) 75%
Live body wt.(gm)	2298	2299	2296	2306
Carcass (%)	57.74	58.45	59.21	59.95
Liver (%)	2.75±0.15	2.79±0.13	2.83±0.15	2.92±0.25
Kidney (%)	0.73±0.02	0.75±0.01	0.69±0.07	0.68±0.07
Heart (%)	0.33±0.11	0.35±0.11	0.35±0.04	0.34±0.07
Dressing percent (DP%)	61.74	62.24	61.44	61.44
Caecum (%)	5.83 ±0.68	5.14 ±0.25	5.63 ±0.31	5.56 ±0.65
Full stomach (%)	7.74 ±0.68	7.18±0.17	7.13±0.30	7.11±0.68
Visc. (%)	6.20±2.89	6.63±0.01	6.14±0.18	6.39±0.44
Head (%)	6.15±0.31	5.98±0.07	5.83±0.14	5.99±0.08
Caecum length (cm)	41.22±1.31	41.26±1.31	41.25±1.31	41.66±1.31

All means in the same row were not significantly different (P<0.05).

Table (7): Effect of dried citrus pulp substitution treatments on biochemical parameters measured in blood

	Level of dried citrus pulp replacement (%)			
	Group1 (T1) 0%	Group 2 (T2) 25%	Group 3 (T3) 50%	Group 4 (T4) 75%
Total Protein (gm/dl)	6.31±0.61	6.35±0.64	6.43±0.65	6.52±0.40
Albumin (gm/dl)	2.40±0.12	2.40±0.07	2.41±0.19	2.40±0.08
Globulin (gm/dl)	3.91±0.66	3.95±0.68	4.02 ±0.67	4.12±0.41
Total Lipids (gm/dl)	3.20±0.38	3.31±0.59	3.32±0.27	3.32±0.28
Urea (mg / dl)	68.70±2.70	68.51±6.77	68.80±6.02	69.50±4.08
Creatinine (mg / dl)	0.65±0.04	0.67±0.12	0.68±0.08	0.69±0.06
AST (IU / L)	189.70±2.94	190.27±6.4	190.70±3.17	190.90±3.36
ALT (IU / L)	56.90±1.52	57.6±1.93	58.00±2.53	59.80±1.36

AST= Aspartate amino transferase, ALT= Alanine amino transferase,

Table (8): Economic evaluation of the experimental diets.

	Level of dried citrus pulp replacement (%)			
	Group1 (T1) 0%	Group 2 (T2) 25%	Group 3 (T3) 50%	Group 4 (T4) 75%
initial weight (g) (D)	650	649	643	647
Price diet /kg EL(A)	1.35	1.29	1.23	1.17
BW (g) B	2298	2299	2296	2306
Feed consumption (1-8 weeks) (Kg) (C)	5.891	6.040	6.130	6.180
Total feed cost (EL) A*C (F)	7.954	7.791	7.540	7.231
Average gain in weight (Kg) B-D (G)	1.648	1.650	1.653	1.659
Price/kg WG (LE) (R)	16	16	16	16
Total revenue (LE) G*R (T)	26.368	26.400	26.448	26.544
Net revenue (LE) T-F (S)	18.414	18.609	18.908	19.313
Economic efficiency (E.E.) S / F	2.32	2.39	2.51	2.67
Relative economic efficiency	100	103	108	115

CONCLUSION

Conclusively, there were no symptoms of digestive or metabolic upsets and no apparent negative effect when rabbit fed dried citrus pulp instead of part of maize, which improve its nutritive value and palatability, which help microorganisms to do effectively. It appears to be technically feasible to partially replace maize with dried citrus pulp in pelleted diets for growing rabbit which resulted in similar values as the control. Moreover, costs were considerably less for the dried citrus pulp diets as compared to the control.

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تأثير إحلال بواقى عصير البرتقال الجاف محل الذرة على النمو و معاملات الهضم و مكونات الدم في علائق الأرانب

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تمت هذة الدراسة على ٤٠ ارنب نيوزيلاندى ابيض عمر ستة اسابيع بمتوسط وزن٦٤٧,٢٥ جرام مقسمة على اربع مجموعات تجريبية و استهدفت هذه الدراسة احلال بواقى عصير البرتقال الجاف كمصدر رخيص للطاقة محل الذرة بنسب صفر، ٢٥، ٥٠، ٧٥% من كمية الذرة في العلائق المركزة للأرانب بهدف خفض تكاليف الإنتاج. تم تركيب العلائق بحيث تفي باحتياجات الأرانب النامية من البروتين و الطاقة.

استمرت الدراسة ٨ أسابيع و فى الأسبوع الثامن من تجربة النمو أجريت تجربة هضم استخدم فيها ٥ حيوانات لفترة جمع ٥ أيام. أوضحت نتائج الدراسة بالنسبة لمتوسط المادة الجافة ا لمأكولة انه لا يوجد اختلافات معنوية بين العلائق تحت الدراسة مما يدل على استساغة الأرانب الجيدة للعلائق المحتوية على بواقى عصير البرتقال الجاف وان كان هناك زيادة غير معنوية لمعظم معاملات هضم المركبات الغذائية المختلفة. وكذلك الحال بالنسبة للحموضة والأحماض الدهنية الطيارة. أيضاً أشارت النتائج إلى أنه لم يكن هناك إختلافات معنوية فى وزن الذبيحة أو مكونات الدم فى الأرانب التى تغذت على بواقى عصير البرتقال الجاف.

و من هذا يتضح أن استخدام بواقى عصير البرتقال الجاف كمصدر رخيص للطاقة بدلا من الذرة في علائق الأرانب النامية لم يكن له آي تأثير ضار على النمو أو معاملات الهضم للمركبات الغذائية المختلفة مما يتيح الفرصة لاستخدام مصدر طاقة رخيص في علائق الأرانب النامية و بالتالي خفض تكاليف الإنتاج مما ينعكس على سعر بيع المنتج النهائي و انتشار لحم الأرانب كمصدر للبروتين الحيواني.