Proc. 3[rd] All Africa Conf. Anim. Agric. & 11[th] Conf. Egyptian Soc. Anim. Prod., Alexandria, Egypt, 6-9 November 2000: 163-170

EFFECT OF INCORPORATING KITCHEN RESIDUALS IN RABBIT'S DIETS ON INTAKE, DIGESTIBILITY AND PERFORMANCE

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SUMMARY

Fifty-five New- Zealand white rabbits were used in the present study. The 1st experiment involved three males aged 16 weeks, average weight 2387.5 ± 42.7 gm were fed 100% restaurant food wastes (R.F.W) to investigate their nutritive value. The 2nd experiment aimed to study the effect of incorporating R.F.W. on the performance of growing rabbits and meat quality. Fifty-two New-Zealand White rabbits (40 males and 12 females) aged four weeks were divided into four equal groups and fed four experimental diets containing 0, 25, 35 and 50% (R.F.W.). All diets were formulated to be nearly isoenergetic and isontrogenous except the 4th group (50% R.F.W.) contained higher energy. Results revealed that, R.F.W. had better digistibilities and feeding value than some other kinds of food manufacturing by-products. Incorporating R.F.W. in rabbit's diets improved significantly the final weight, average total gain, average daily feed intake and meat quality than control diet (0% R.F.W.) except at the level 50% R.F.W. the total body fat increased significantly. The relative average final live weight was 115, 125 and 118% for 25, 35 and 50% R. F. W. respectively compared with the control diet. Incorporating R.F.W. in rabbit's diets decreased the total costs of the formulated rations by about 17.43, 22.27 and 23.43% per ton for diets containing 25, 35 and 50% R. F. W. respectively compared to the commercial diet (control diet).

***Keywords:** Rabbits, restaurant food wastes, growth performance, carcass evaluation*

INTRODUCTION

There are attraction in considering food wastes in animal feeding as they help to avoid the immediate competition of resources between man and animals. Using food wastes for animal nutrition has a number of limitation which need to be considered prior to their incorporation in animal's diets. The value of food wastes depends on their ability to meet the needs of animal's requirements for particular productive processes. The food wastes themselves will be of value depending on their chemical composition, initial concentration of energy and nutrients, their moisture content, presence of non-nutritive factors and influence of processing and preparation. Kornegy *et al.*, 1965 found that, the chemical composition and nutritive value of garbage's showed number of significant differences among their types and sources. Accordingly, it is important that, the food wastes should be processed before incorporation in animal diets. Food wates processing applied were autoclaving (Lyso and Homb, 1982), homogenizing (Gordeev, 1983), drying and sterilizing by Gamma irradiation (Lipstein, 1985), while Sebek *et al.*, (1990) used ensiling to process food wastes.

The objective of the present work is to study the nutritive value of popular restaurant food wastes (R.F.W) and the possibility of incorporating them in growing rabbit's diets and their effects on the performance and feed utilization.

MATERIALS AND METHODS

Preparation of the tested product

Garbage of a 3[rd] class restaurant was collected daily and partitioned into edible parts (R.F.W) and non-edible parts and the last portion was about 60% of the total garbage. The fresh R.F.W. was processed through 3 steps to prepare them into a suitable form for rabbits feeding. The steps of processing could be summarized as follows.

1[st] step: samples were homogenized and dried daily for one month in an electric oven at 65°C for 24 hours, then ground (1 mm mesh).

2[nd] step: another fresh big quantity was homogenized and then cooked for sterilization. Process of cooking was done by using the effect of the direct heat on the R.F.W. for about half an hour at about 100°C and one atmospheric pressure.

The 3[rd] step was mixing the cooked R.F.W with the previous dried material at a ratio 3: 1 to reduce the moisture content (to about 30%). and then spread in a sunny place for 24 hours to final drying (about 8% moisture).

Experimental diets formulation

Four experimental diets T_1, T_2, T_3 and T_4 were prepared to contain 0, 25, 35 and 50% prepared R.F.W respectively (Table 2). The four diets were formulated to be nearly isoenergetic and iosnitrogenous (except T_4 which was higher in energy content) according to the recommendation of N.R.C. 1977 for growing rabbits for CP, CF and TDN (Table 1).

Table 1. Composition of the experimental diets. (DM basis)

	Experimental diets			
	0% (T1)	25%(T2)	35% (T3)	50% (T4)
Ingredients %				
R.F.W**	00.00	25.00	35.00	50.00
Clover hay	28.30	20.00	10.00	13.00
Wheat bran	40.00	34.00	22.00	10.00
Soybean meal	5.00	6.00	8.00	9.00
Decotton S.M.	6.00	6.00	8.00	6.00
Yellow corn	15.53	0.00	0.00	0.00
Corn cobs	0.00	4.0	11.0	6.0
Molasses	3.00	3.00	4.00	4.00
Bone meal	0.50	0.55	0.55	0.55
Common salt	0.50	0.45	0.45	0.45
Limestone	0.60	0.45	0.45	0.45
Min. + Vit. Premix	0.50	0.50	0.50	0.50
Methionine	0.07	0.05	0.05	0.05
Crude protein*	18.20	17.84	17.54	17.27
Crude fiber*	13.96	15.84	15.65	15.61
T.D.N*	65.80	67.08	67.05	73.29

* Calculated according to the chemical composition and mutative values of the ingredients (NRC, 1977).
** Chemical analysis and nutritive value were determined (experiment No. 1).

Table 2. Chemical analysis and gross energy of restaurant food wastes (RFW) and experimental diets (DM basis)

Chemical analysis	Experimental diets				
and gross energy	100%	0% (T1)	25% (T2)	35% (T3)	50% (T4)
Moisture	9.90	8.70	10.50	9.60	9.50
OM	87.78	92.33	88.84	90.38	89.72
CP	12.11	19.0	18.14	18.30	17.90
EE	11.80	3.09	6.03	6.75	9.09
CF	14.76	14.15	13.41	13.0	13.48
NFE	49.11	56.09	51.26	50.33	48.25
Ash	12.22	7.67	11.16	11.62	11.28
GE* (Kcal/kg)	4444.00	4301.00	4273.00	4237.00	4419.00

* Calculated from the chemical analysis according to McDonald *et al.* (1977).

Evaluation trial (1[st] experiment)

The previous dried R.F.W were used in direct digestibility trial to determine the digestion cofficients and nutritional value, using three male New-Zealand white rabbits aged 16 weeks with an average live body weight of 2387.5 gm ± 42.7 gm (Table3).

Feeding trials (2[nd] experiment)

Fifty-two New-Zealand white rabbits (4 weeks old) were divided into equal four groups (40 males) and were assigned at random to receive diets T_1, T_2, T_3 and T_4 during an experimental period of eight weeks. The experimental animals were individually housed in galvanized metabolic cages (60 × 60 × 40 cm) which were designed for digestion trials. Water and food were provided *ad-libitum* during the

Table 3. Digestion coefficient and nutritive values of dried restaurant food wastes and the experimental diets ($\overline{X}$ ±SE)

Item	R.F.W.	Experimental diets				
	100%	0%RFW (T_1)	25%RFW (T_2)	35%RFW (T_3)	50%RFW (T_4)	SE
Digestion coefficients						
DM	82.39±0.50	67.77±2.51	71.67±0.84	71.13±2.37	72.37±1.35	1.82
OM	73.62±0.45	69.90±2.26	71.7±0.82	70.75±2.41	74.78±0.95	
CP	77.56±0.78	80.41±2.22	77.02±1.35	78.17±2.05	80.84±1.47	1.81
EE	94.60±0.27	80.54±1.89^{a}	85.51±1.27^{b}	85.84±3.23^{bc}	91.77±1.81^{d}	2.18
CF	55.11±1.89	29.89±5.61	41.25±0.59	35.22±5.46	43.55±8.47	0.87
NFE	91.50±0.60	75.96±1.22	76.24±0.94	75.35±1.73	78.00±1.18	1.38
Nutritive values						
DCP	9.39±0.1	15.60±43	16.33±0.29	15.15±0.40	15.44±0.28	0.36
TDN	87.57±0.49	67.85±2.11^{a}	70.21±0.69^{a}	69.77±2.37^{a}	76.74±1.00^{b}	1.70
DE**	3879.67±21.70	2985.4±92.80	3089.24±0.36	3069.88±104.28	3376.56±44.00	
C/P ratio	320.4:1	153.9:1	170.3:1	167.8:1	188.6:1	
Feed intake (g/day)	69.51±1.33	75±4.78	89±7.02	98±8.02	94±1.7	5.96
N.R	1:8.33	1:3.35	1:3.36	1:3.61	1:4	
(E/P Kcal DE/g)	41.3	19.1	19.2	20.2	21.9	

** Calculated:

- TDN can be converted to D.E. by the relationship 1kg of TDN = 4.4 M cal of DE.
- Dry matter basis.
- a, b, c. and d means on the same line bearing the same superscripts are not significantly different at $P < 0.05$.
- C/P ratio (caloric /Protein ratio) = $\frac{DE\ of\ 1kg\ of\ ration}{CP\%\ of\ the\ ration}$
- N. R (Nutritive ratio) = $\frac{DCP\%\ of\ 1kg\ of\ ration}{TDN} - 1.0$
- E/P (k cal /g) = Amount of DE / 1 g DCP.

experimental period. At the end of the feeding trials, three rabbits from each group were used in another four digestibility trials to evaluate the experimental diets. Three males and 3 females were chosen after the feeding trials for slaughter test.

Chemical and statistical analysis:

The routine analysis of feeds and feces were carried out according to A.O.A.C. (1984). Boneless breast and thigh muscles were subjected for nitrogen, lipid, ash, moisture and cholesterol determination. Total lipids in the tissues were determined by the method of Floch *et al.* (1957). The method of Caurohami *et al.* (1959) was used to determine total cholesterol content of the total lipids of animal tissues. Statistical analysis of data was done according Snedecor (1959). Difference between means was compared by least significant range (L.S.R.) at the 5% level of probability.

RESULTS AND DISCUSSION

The first experiment (evaluation trial):

Results in table 3 shows digestion coefficients, nutritive values, C/P ratio, feed intake, nutritive ratio (NR) and DE content per one gram DCP (E/P kcal DE/g) of the dried R.F.W and the four experimental treatments (0,25,35 and 50% R.F.W). The results showed that, the dried R.F.W were characterized by increasing digestion coefficients of DM, OM, CP, EE, CF and NFE. Nutritive value of R.F.W expressed as TDN and DE were high, while DCP was low. The high EE digestibility of R.F.W is probably associated with the high EE content (Table 2) as it was mentioned by Clawson *et al.*(1962) who cited that, the digestion coefficient of EE increased when fat content increased specially unsaturated oil. The high CF digestibility of R.F.W is also probably due to the cooking process, nature of fiber, the portions of cellulose, himicellulose and lignin. The calculated DE of R.F.W was in agreement with that reported by Gloridoss and Das, 1985. By comparing the DCP of R.F.W with other feed stuffs it was found that, DCP of R.F.W was lower than horse bean (21.63 gm) and fish meal (53.82 gm), however it was higher than corn grains (7.22 gm) and 2[nd] cut green clover (1.65 gm). The obtained results showed that, the daily feed intake 100% of R.F.W was low and nutritive ratio NR was wide. This result may be due to the decrease of the palatability resulting from the high EE content (11.8%). Generally it was concluded that R.F.W are not suitable for rabbit's feeding as such because they are characterized by high TDN, C/P ratio, low DCP and wide N.R

The second experiment (feeding trials):

Results in Table 4 shows the effect of incorporating R.F.W in growing rabbit's diets (4-12 weeks old) on feed intake and growth performance. The obtained results revealed that, incorporating R.F.W in rabbit's diets appeared to have an effect ($p < 0.05$) on the variability of average daily feed intake, the final weight, average total gain weight, average daily gain and mortality rate while feed efficiency was not affected significantly. The least significant range (L.S.R) method revealed that, the final live weight of rabbits fed graded levels of R.F.W. (25, 35 and 50%) increased significantly compared with the control treatment (0% R.F.W) while the differences were insignificant among the groups fed 25, 35 and 50% R.F.W. The rabbits of the group fed 0% R.F.W. had the lowest final live weight, while the rabbits of the group fed 35% had the highest value. By considering the average final live weight of group (0% R.F.W) as 100, the relative live weight of the other groups were 115, 126 and 118% (25, 35 and 50% R.F.W.) respectively. The result obtained by Castelline and Battaglini, 1992 revealed that the mean daily gain was slightly higher than that obtained in the present study (25, 35 and 50% R.F.W). They also reported that the mean daily gain was 37.8 and 39.59 when two groups of growing rabbits fed diet containing DE 2655 or 2990 Kcal/kg. The good effect of incorporating R.F.W in rabbits, diets could be explained by processing them with protein supplementation such as soybean meal to meet protein requirements of rabbits as it was reported by Draper, 1945 who found that, processing garbage gave satisfactory results. when fortified with soybean or sardine fish meal as protein supplement. Chiericato and Lamari, (1972) recorded an indirect effect of high dietary fat content as well as the direct effect of heating and cooking processes on improving palatability and hence the daily feed intake (Table 4). The results showed that the effect of incorporating R.F.W. in rabbits diets on mortality rates were not significant. The rates of mortality were 10, 0 20 and 10% for the groups fed 0, 25, 35 and 50% R.F.W at the 7[th], 5[th] and 6[th] week respectively. It can concluded that, the mortality may occur due to natural reasons and not apparently referred to the effect of ration or may be due to the unsuitable temperature, where most mortality appeared during early age. The results of digestibility trials of the four treatments (0, 25, 35 and 50% R.F.W) given in table 3 indicate that, the digestion coefficients of DM, OM, CP, CF, and NFE were not affected significantly by increasing the graded levels of R.F.W, while EE digestibility increased significantly. The high digestion coefficient of EE was probably associated with

Table 4. Effect of incorporating R.F.W. in the experimental diet on rabbit performance

Item	Level of R.F.W in the diet %			
	0	25	35	50
No. of animals	10	10	10	10
Total exp. Period, days	56	56	56	56
Initial weight, g	362	349	362	362
Final weight, g	1658[a]	1914[b]	2081[b]	1949[b]
Av. Total gain, g.	1296[a]	1565[b]	1719[b]	1587[b]
Av. Daily gain, g	25[a]	30[b]	33[b]	31[b]
Feed intake per day*	68[a]	80[b]	89[b]	85[b]
Feed efficiency*	2.96	2.87	2.88	3.00
Relative live weight %	458	548	575	538
Relative growth rate %	358	448	475	438
Mortality rate %	10	0	20	10

* Air dry matter.

a , b means on the same column bearing the same superscripts are not significantly different at $P < 0.05$.

the high EE content of the experimental diets (Table 2) as it was found by Lowrey *et al.* (1962) who reported that. the digestion coefficient of EE increased when the level of fat increased. The values of carcass characteristics of slaughtered rabbits as affected by incorporating R.F.W are given in table 4 and 5. The results revealed that the great effects of incorporating R.F.W in rabbit's diets on carcass characteristics appeared mainly in the abdominal fat percent. Up to 25% R.F.W the abdominal fat percent was low and normal as it was cited by Castellini and Battaglini 1992 who found that the carcass fat recorded 2.51 and 3.1% at DE 2.65 or 2.99 M cal/kg respectively. When the level of R.F.W increased from 35 to 50% the abdominal fat percent increased significantly. Liver percent increased significantly in the group which was fed 50% R.F.W compared with 0% R.F.W. Dressing, boneless, heart and fur were affected significantly by incorporating graded levels of R.F.W. It can be concluded that, these significant differences of carcass characteristics may occur due to the differences in C/P ratio (table 3), as it was reported by Fraga *et al.*, 1983 who found that the higher dietary energy to protein ratio increased the proportion of body fat. The approximate analysis of boneless meat of rabbits (male and female) in terms of moisture, protein and total lipids percent were not affected significantly by incorporating R.F.W. in rabbit's diets up to 35% (iso – caloric and iso – protein diets) while it was affected significantly when the R.F.W. was 50%. The high percentage of the total lipids and the abdominal fat of the group fed 50% R.F.W. was probably due to the increasing of the DE content compared with that required for rabbits (Table 3). The cholesterol content of rabbit's boneles meat was not affected significantly by incorporating R.F.W. in rabbits diets. From a simple economical point of view it was found that incorporating R.F.W. in rabbit's diets decreased the total costs of the experimental diet (25, 35 and 50% R.F.W) by 17.43, 22.27 and 23.43% of total costs of the control diet (0% R.F.W.). However it is worthy to note that the total costs for preparing one ton dried R.F.W. is not constant but it can be minimized in mass production by considering the heating processing at 65°C is done once for the 1[st] unit and then the dried wastes is used automatically to dry new fresh R.F.W by ratio 3:1.

From the previous results it may be concluded that the replacement of rabbit diets by restaurant food wastes up to 35% is considerably right from he nutritional and economical point of view without any deleterious effect on rabbit performance and carcass characteristics.

Table 5. Effect of incorporating restaurant food wastes (RFW) in rabbit's diets on carcass characteristics ($\overline{X}$ ± SE)

Level of R.F.W	No. of rabbits	Preslaughter weight (gm)	Head (%)	Abdominal fat (%)	Edible parts %					Non edible parts %	
					Liver	Dressing	Boneless	Heart	Kidneys	Fur	Gut
0% (Group1)											
♀	3	1573±26.67	8.22±0.05^{a}	3.71±0.20^{a}	2.92±0.03^{a}	48.50±0.67^{a}	33.56±0.10^{a}	0.19±0.00	0.52±0.01	12.11±0.51^{a}	10.16±0.1
♂	3	1613±20.28	8.33±0.12	3.20±0.11^{a}	2.86±0.04	47.78±0.60^{a}	33.28±0.28^{a}	0.14±0.01^{a}	0.54±0.01	11.64±0.45^{a}	10.43±0.40
Mean		1593	8.28	3.46	2.89	48.14	33.42	0.17	0.53	11.88	10.30
25% (Group2)											
♀	3	1923±17.64	8.67±0.08^{b}	3.93±0.52^{a}	3.08±0.08^{ac}	50.33±0.82^{ac}	36.22±0.34^{b}	0.22±0.0	0.77±0.08	13.37±0.92^{ac}	9.80±0.67
♂	3	2003±20.28	8.37±0.12	3.46±0.42^{ac}	2.92±0.11	49.89±0.92^{ac}	35.57±0.47^{ac}	0.21±0.02b	0.71±0.05	13.29±0.87^{b}	10.04±0.56
Mean		1963	8.52	3.70	3.00	50.11	35.90	0.22	0.74	13.33	10.1
35% (Group3)											
♀	3	2017±33.33	8.58±0.15^{b}	5.73±0.47^{b}	2.59±0.14^{ac}	52.85±0.56^{bc}	39.10±.0.53^{bd}	0.20±0.00	0.62±0.04	13.23±0.28^{ac}	8.34±0.33
♂	3	2067±16.67	8.50±0.06	4.94±0.78b^{c}	2.62±0.18	53.20±0.55^{bc}	39.06±0.45^{bc}	0.21±0.00^{b}	0.61±0.03	13.47±0.19^{b}	8.41±0.52
Mean		2042	8.54	5.34	2.61	53.03	39.08	0.21	0.74	13.35	8.38
50% (Group4)											
♀	3	1882±18.78	8.72±0.01^{b}	6.55±0.40^{b}	2.94±0.1^{bc}	52.29±0.97^{bc}	36.92±1.24^{Cd}	0.20±0.01	0.80±0.12	14.87±0.15^{bc}	8.83±0.86
♂	3	1933±16.67	8.79±0.12	6.04±0.40^{b}	2.94±0.10	51.92±1.10^{bc}	36.79±1.20^{b}	0.20±0.01b	0.79±0.12	14.79±0.06^{b}	9.93±0.86
Mean		1908	8.76	6.30	2.94	52.11	36.86	0.20	0.62	14.83	8.88
Standard error			0.100	0.420	0.100	0.768	0.698	0.010	0.115	0.551	0.592
♀			0.100	0.490	0.115	0.827	0.757	0.013	0.058	0.500	0.608
♂											

Dressing percent is measured as hot carcass + liver + heart + kidneys divided by preslaughter WT. x 100.
Fur includes: Fur + legs + tail divided by preslaughter WT. x 100.
% Calculated as percent of preslaughter weight.
a, b, c and d means on the same column bearing the same superscripts are not significantly different at P<0.05.

Table 6. Effect of incorporating restaurant food wastes in rabbit's diets on the proximate analysis and cholesterol content of boneless meat ($\overline{X}$ ±SE)

Item	No. of rabbits	Level of R.F.W											
		0 % T_1			25% T_2			35% T_3			50% T_4		
		♂	♀	Mean	♂	♀	Mean	♂	♀	Mean	♂	♀	Mean
Moisture	3	73.46[b]	72.12b	72.79	73.00ab	71.83b	72.42	74.07b	72.08	73.08	72.34a	70.68a	71.51
		±0.33	±0.13		±0.33	±0.24		±0.33	±0.20		±0.27	±0.25	
Protein*	3	18.65b	17.80b	18.23	18.56b	17.44b	18.00	18.97b	17.80b	18.39	17.01a	15.93a	16.47
		±0.20	±0.53		±0.20	±0.27		±0.02	±0.20		±0.09	±0.23	
Total lipids*	3	8.36a	9.49a	8.93	9.07a	9.95a	9.51	8.89a	9.71a	9.30	12.36b	14.00b	13.18
		±0.2	±0.23		±0.17	±0.07		±0.45	±0.32		±0.06	±0.10	
Ash**	3	3.26	3.29	3.28	3.20	3.38	3.29	3.20	3.32	3.26	3.26	3.38	3.32
		±0.10	±0.10		±0.01	±0.17		±0.10	±0.20		±0.07	±0.19	
Cholesterol**	3	165.67	175.00	170.38	168.00	191.7	179.80	176.67	185	180.84	181.67	211.67	196.76
mg / 100 g meat		±3.52	±6.66		±4.04	±2.91		±2.58	±2.31		±6.57	±7.26	

* Wet basis.

** Dry matter basis.

a. b and c means on the same line bearing the same superscripts are not significantly different at $P<0.05$.

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