4. RESULTS AND DISCUSSION

4.1. Growth performance:

4.1.1. Live body weight:

Live body weight (LBW) of growing New Zealand White (NZW) rabbits as affected by dietary treatments at different ages of the experimental period (5-13) weeks of age are shown in Table (2). The initial LBW of rabbits within all treatments at the start of the experiment (5 weeks of age) were nearly similar (ranged between 521.03 and 522.00 g, with no significant differences), Table (2).

At 9 weeks of age, rabbits fed 10% coffee pulp recorded the highest LBW, while those fed 30% coffee pulp showed the lowest one. The differences in LBW were significant ($P < 0.001$), Table (2). However, rabbits fed 20% potato peel, 10% potato peel and the control diet recorded nearly the same LBW values, without significant differences being 1166.03, 1161.80 and 1158.13 g, respectively.

Results of LBW at 13 weeks of age (Table 2) showed that rabbits of 10% potato peel fed group recorded the highest LBW followed by those of 10% coffee pulp fed group with no significant differences in LBW between the two treatments. Whereas, rabbits of 20% coffee pulp fed group achieved the lowest ($P < 0.05$) LBW. However, the differences in LBW between rabbits fed the control diet and those fed either 30% potato peel or 30% coffee pulp were not significant.

In general, using either potato peel or coffee pulp in growing NZW rabbit diets almost improved LBW at the

different ages studied. This improvement may be attributed to the effect of heat treatment during the pelleting process of diets which deactivates proteolytic enzyme inhibitors (trypsin inhibitor) and partially denaturats the starch **(Watt, 1973 and Lunen *et al.*, 1989).** Also, heat treatment has the potential of altering potato starch by disrupting the protein matrix surrounding the starch granules making it more vulnerable to amylolysis that may be the reasons of increasing efficiency of rabbits in utilizing energy of potato **(Whittemore *et al.*, 1974; Lunen *et al.*, 1989 and Tosu and Hong, 1989).**

Table (2): **Least square means and standard errors for live body weight (g) of growing NZW rabbits as affected by dietary treatments at different ages of the experimental period (5-13 weeks of age).**

Treatment	Age in weeks		
	5	9	13
	Means ± SE	Means ± SE	Means ± SE
Control	521.13 ± 0.80	1158.13 ± 2.11^{cb}	1832.13 ± 24.57^{c}
Potato peel			
10%	521.80 ± 0.80	1161.80 ± 2.11^{cb}	2022.80 ± 24.57^{a}
20%	521.03 ± 0.80	1166.03 ± 2.11^{b}	1907.03 ± 24.57^{b}
30%	521.96 ± 0.80	1136.96 ± 2.11^{d}	1821.96 ± 24.57^{c}
Coffee pulp			
10%	522.00 ± 0.80	1177.50 ± 2.11^{a}	1962.50± 24.57^{ab}
20%	521.76 ± 0.80	1155.00 ± 2.11^{c}	1518.00 ± 24.57^{d}
30%	521.48 ± 0.80	1114.13 ± 2.11^{e}	1772.13 ± 24.57^{c}
Significance	NS	***	***

a, b, c, d and e: means in the same column with different superscripts are significantly ($P < 0.05$) different

NS = not significant *** = ($P < 0.001$)

Results of **Agwunobi *et al.* (1997) and Helaly *et al.* (2002)** did not show any significant differences in LBW of rabbits due to using sweet potato in their diets.

4.1.2. Daily weight gain:

The effect of dietary treatments on daily weight gain (WG) of growing NZW rabbits at different intervals of the experimental period (5-13 weeks of age) are presented in Table (3).

Results of daily WG during the 5-9 weeks of age interval (Table 3) showed that rabbits fed either 20% potato peel or 10% coffee pulp recorded the highest daily WG and those fed 30% coffee pulp showed the lowest one, with significant differences ($P < 0.05$) indicating nearly the same results of LBW at 9 weeks of age. However, the differences in daily WG between rabbits fed the control diet and those fed either 10% potato peel or 20% coffee pulp were not significant.

At 9-13 weeks of age interval, rabbits of 10% potato peel fed group achieved the highest ($P < 0.05$) daily WG, followed by those of 10% coffee pulp fed group, whereas those of 30% coffee pulp fed group showed the lowest ($P < 0.05$) value.

Daily WG during the whole experimental period (5-13) weeks of age) followed the same pattern observed during the 9-13 weeks of age interval, as rabbits fed either 10% potato peel or 10% coffee pulp recorded higher ($P < 0.05$) daily WG than that of all other treatments, while rabbits fed 30% coffee pulp achieved the lowest ($P < 0.05$) one.

In this concern, **Helaly *et al.* (2002)** showed no significant differences among the growing rabbits fed potato

processing by-products meal. However, group's fed 10, 20 and 30% potato processing by-products meal achieved the best weight gain compared with control group. The improved performance of rabbits fed diets contained sweet potato could be also related to the effect of heating during pelleting process of diets which alters the starch structure of sweet potato, consequently improved the digestibility of starch by amylase enzyme as well as improving the palatability of the diets **(Corring and Rettaglaiti, 1969).**

Table (3): **Least square means and standard errors for daily weight gain (g) of growing NZW rabbits as affected by dietary treatments at different age intervals of the experimental period (5-13 weeks of age).**

Treatment	Age intervals in weeks		
	5-9	9-13	5-13
	Means ± SE	Means ± SE	Means ± SE
Control	22.89 ± 0.00 ^{b}	24.07 ± 0.00 ^{e}	23.48 ± 0.00 ^{e}
Potato peel			
10%	22.85 ± 0.00 ^{b}	30.75 ± 0.00 ^{a}	26.80 ± 0.00 ^{a}
20%	23.03 ± 0.00 ^{a}	26.46 ± 0.00 ^{c}	24.75 ± 0.00 ^{c}
30%	21.96 ± 0.00 ^{c}	24.46 ± 0.00 ^{e}	23.21 ± 0.00 ^{e}
Coffee pulp			
10%	23.39 ± 0.00 ^{a}	28.03 ± 0.00 ^{b}	25.71 ± 0.00 ^{b}
20%	22.57 ± 0.00 ^{b}	25.46 ± 0.00 ^{d}	24.01 ± 0.00 ^{d}
30%	20.85 ± 0.00 ^{d}	23.85 ± 0.00 ^{f}	22.35 ± 0.00 ^{f}
Significance	***	***	***

a, b, c, d, e and f : means in the same column with different superscripts are significantly ($P < 0.05$) different

*** = ($P < 0.001$)

4.2. Feed Utilization:

4.2.1. Daily feed intake :

Values of daily feed intake (FI) of growing NZW rabbits as affected by dietary treatments at different age intervals of the experimental period (5-16 weeks of age) are illustrated in Table (4). During the period from 5 to 9 weeks of age, rabbits of both 30% potato peel and 20% coffee pulp fed groups consumed the highest ($P < 0.05$) amount of daily FI being 108.13 g for each group, while those of the control fed group consumed the lowest ($P < 0.05$) one (97.50 g). However the differences in daily FI among other treatment groups were not-significant (Table 4).

The lowest ($P < 0.05$) daily FI during the period of 9-13 weeks was also recorded by rabbits of the control group (131.07 g) followed by those fed the 30% coffee pulp being 137.13 g. While, the highest ($P < 0.05$) daily FI (163.13 g) was shown by rabbits fed 10% potato peel followed by those fed 10% coffee pulp.

Values of daily FI during the whole experimental period (5-13 weeks of age) showed that rabbits of the control group and 30% coffee pulp fed group consumed the lowest ($P < 0.05$) daily FI being 114.07 and 125.13g, respectively. While those fed 10% potato peel and 10% coffee pulp recorded the highest daily FI being 133.13 and 131.13 g, respectively, indicating the same trend observed during the period of 9-13 weeks of age. Daily FI of other treatments ranged between 127.00 and 129.13 g, with no significant differences (Table 4).

The increase in FI of groups fed either potato peel or coffee pulp by-products compared with their control may be due

to the improvement in the palatability of the diets contained these by-products. In agreement with the previous results, **Helaly *et al.* (2002)** reported that rabbits fed potato processing by-products consumed more FI ($P < 0.05$) compared with their control. Whereas, **Agwunobi *et al.* (1997)** showed that FI was not significantly affected by replacement of maize with sweet potato meal in rabbit diets.

Results in Table (4) showed that FI decreased with increasing dietary coffee pulp level, similarly **Donkoh *et al.* (1988)** indicated that feed consumption was significantly and inversely related with the concentration of dried coffee pulp in the diets of commercial broiler chickens.

Table (4): **Least square means and standard errors for daily feed intake (g) of growing NZW rabbits as affected by dietary treatments at different age intervals of the experimental period (5-13 weeks of age).**

Treatment	Age intervals in weeks		
	5-9	9-13	5-13
	Means ± SE	Means ± SE	Means ± SE
Control	97.50 ± 0.77 ^{c}	131.07 ± 0.98 ^{g}	114.07 ± 0.78 ^{e}
Potato peel			
10%	102.13 ± 0.77 ^{b}	163.13 ± 0.98 ^{a}	133.13 ± 0.78 ^{a}
20%	104.13 ± 0.77 ^{b}	154.13 ± 0.98 ^{c}	129.13 ± 0.78 ^{bc}
30%	108.13 ± 0.77 ^{a}	146.13 ± 0.98 ^{e}	127.00 ± 0.78 ^{cd}
Coffee pulp			
10%	104.13 ± 0.77 ^{b}	158.13 ± 0.98 ^{b}	131.13 ± 0.78 ^{ab}
20%	108.13 ± 0.77 ^{a}	151.13 ± 0.98 ^{d}	129.13 ± 0.78 ^{bc}
30%	104.13 ± 0.77 ^{b}	137.13 ± 0.98 ^{f}	125.13 ± 0.78 ^{d}
Significance	***	***	***

a, b, c, d, e, f and g: means in the same column with different superscripts are significantly ($P < 0.05$) different

*** = ($P < 0.001$)

4.2.2. Feed conversion:

Least square means of the effect of dietary treatments on feed conversion (FC) of growing NZW rabbits at different age intervals of the experimental period (5-13 weeks of age) are presented in Table (5). Rabbits fed the control diet showed the best ($P < 0.05$) FC value (4.196) during the 5-9 weeks of age interval, followed by those fed 10% coffee pulp, 10% and 20% potato peel being 4.452, 4.470 and 4.522, respectively with no significant differences among these latter groups. The poorest FC values were recorded by rabbits fed 30% coffee pulp (4.994) and 30% potato peel (4.916), the differences were not significant.

Values of FC at the period of 9-13 weeks of age cleared that rabbits of 10% potato peel fed group showed the best FC value (5.305), followed by those of the control fed group (5.481), with no significant differences, while, rabbits of 20% potato peel, 20% coffee pulp and 30% potato peel fed groups recorded the poorest FC values (5.825, 5.936 and 5.974, respectively), with no significant differences among the three treatments.

Results of the whole experimental period (5-13 weeks of age), indicated that the best ($P < 0.05$) FC value (4.858) was achieved by rabbits fed the control diet, followed by that of rabbits fed 10% potato peel and 10%coffee pulp diets being 4.968 and 5.100, respectively. However, the differences were significant ($P < 0.05$) between these three treatments as shown in Table (5). Rabbits fed 30% coffee pulp exhibited the poorest ($P < 0.05$) FC value (5.599), followed by those fed 30% potato peel (5.485), with significant ($P < 0.05$) differences.

In this connection, most studies on different agricultural and industrial by-products claimed that FC values were almost inversely affected with adding and increasing the dietary level of these by-products. Feed conversion values were inversely ($P < 0.05$) affected by dried potato tops to 30% **(Awad, 1997),** sugar beet tops **(Tag El-Dain *et al.*, 2000),** dehydrated soluble potato solids **(Soliman and El-Tawel, 2001),** potato processing by-products meal and discarded sweet potato tubers meal **(Helaly *et al.*, 2002)** and sugar beet pulp **(El-Hendawy *et al.*, 2004).** However, feed conversion values were not significantly affected by using sweet potato tops hay to 30% **(Soliman, 1995),** sweet potato tops or roots **(Ali *et al.*, 1999)** and olive pulp **(Mousa and Abd El-Samee, 2002).**

Table (5): **Least square means and standard errors for feed conversion (g feed / g gain) of growing NZW rabbits as affected by dietary treatments at different age intervals of the experimental period (5-13 weeks of age).**

Treatment	Age intervals in weeks		
	5-9	9-13	5-13
	Means ± SE	Means ± SE	Means ± SE
Control	4.196 ± 0.039 ^{d}	5.481 ± 0.077 ^{cd}	4.858 ± 0.032 ^{g}
Potato peel			
10%	4.470 ± 0.038 ^{c}	5.305 ± 0.077 ^{d}	4.968 ± 0.032 ^{f}
20%	4.522 ± 0.038 ^{c}	5.825 ± 0.077 ^{ab}	5.218 ± 0.032 ^{d}
30%	4.916 ± 0.038 ^{a}	5.974 ± 0.077 ^{a}	5.485 ± 0.032 ^{b}
Coffee pulp			
10%	4.452 ± 0.038 ^{c}	5.642 ± 0.077 ^{bc}	5.100 ± 0.032 ^{e}
20%	4.791 ± 0.038 ^{b}	5.936 ± 0.077 ^{a}	5.378 ± 0.032 ^{c}
30%	4.994 ± 0.038 ^{a}	5.591 ± 0.077 ^{c}	5.599 ± 0.032 ^{a}
Significance	***	***	***

a, b, c, d, e, f and g: means in the same column with different superscripts are significantly ($P < 0.05$) different

*** = ($P < 0.001$)

Donkoh *et al.* (1988) in a trial with commercial broiler chickens, claimed that the concentration of dietary dried coffee pulp was correlated with feed conversion ratio ($r = 0.88$). While,

Okai and Dabo (1991) demonstrated that replacing wheat bran with 0, 10, 20 and 30% dried coffee pulp in the diet of Large White pigs did not influence feed conversion.

4.3. Nutrient Digestibility And Feeding Values:

Data for nutrients digestibility and feeding values of growing NZW rabbits as affected by dietary treatments at 13 weeks of age are illustrated in Table (6). Statistical analysis showed that the differences in digestibility of all nutrients due to treatment effects were significant ($P < 0.001$). Digestibility values ranged between 57.21% (control treatment) and 68.79% (10% potato peel treatment) for DM, 46.81% (control treatment) and 69.64% (30% potato peel treatment) for OM, 66.30% (10% coffee pulp treatment) and 72.06% (20% potato peel treatment) for CP, 34.52% (30% coffee pulp treatment) and 62.43% (control treatment) for CF, 50.16% (control treatment) and 76.25% (10% potato peel treatment) for EE and 68.84% (control treatment) and 75.52% (20% coffee pulp treatment) for NFE.

Results in Table (6) indicated that rabbits of the control treatment recorded the lowest DM, OM, EE and NFE digestibility values, and the highest CF digestibility one. Whereas, rabbits of potato peel treatments (10, 20 and 30%) achieved the highest digestibility values for all feed nutrients except NFE digestibility, indicating that potato peel improved the digestibility of DM, OM, CP and EE. However, coffee pulp treatments slightly improved the digestibility of DM, OM, EE and NFE as compared with those of the control treatment.

Table (6): Least square means and standard errors for nutrients digestibility and feeding values of growing NZW rabbits as affected by dietary treatments at 13 weeks of age.

Treatment	Nutrients digestibility (%)						Feeding values (%)		
	DM	OM	CP	CF	EE	NFE	TDN	DCP	DE Kcal/kg
Control	57.21 ± 0.009^{c}	46.81 ± 5.126^{c}	66.89 ± 0.018^{c}	62.43 ± 0.011^{a}	50.16 ± 0.009^{e}	68.84 ± 0.009^{e}	61.68 ± 0.034	10.90 ± 0.013	2719.91 ± 0.00
Potato peel									
10 %	68.79 ± 0.009^{a}	68.68 ± 5.126^{a}	71.17 ± 0.018^{a}	44.26 ± 0.011^{b}	76.25 ± 0.009^{a}	70.16 ± 0.009^{d}	61.39 ± 0.034	11.01 ± 0.013	2707.13 ± 0.00
20 %	66.84 ± 0.009^{b}	69.38 ± 5.126^{a}	72.06 ± 0.018^{a}	43.87 ± 0.011^{b}	75.63 ± 0.009^{a}	70.43 ± 0.009^{d}	61.44 ± 0.034	11.77 ± 0.013	2708.91 ± 0.00
30 %	66.94 ± 0.009^{b}	69.64 ± 5.126^{a}	70.64 ± 0.018^{ab}	44.32 ± 0.011^{b}	74.63 ± 0.009^{b}	71.85 ± 0.009^{c}	61.24 ± 0.034	11.50 ± 0.013	2700.50 ± 0.00
Coffee pulp									
10 %	57.39 ± 0.009^{c}	61.88 ± 5.126^{b}	66.30 ± 0.018^{c}	35.84 ± 0.011^{c}	62.89 ± 0.009^{d}	73.43 ± 0.009^{b}	61.19 ± 0.034	10.91 ± 0.013	2697.87 ± 0.00
20 %	56.94 ± 0.009^{c}	61.42 ± 5.126^{b}	66.92 ± 0.018^{c}	35.36 ± 0.011^{cd}	63.01 ± 0.009^{d}	75.52 ± 0.009^{a}	61.41 ± 0.034	10.94 ± 0.013	2708.88 ± 0.00
30 %	57.31 ± 0.009^{c}	60.24 ± 5.126^{b}	67.22 ± 0.018^{c}	34.52 ± 0.011^{d}	64.42 ± 0.009^{c}	74.34 ± 0.009^{b}	61.42 ± 0.034	11.01 ± 0.013	2707.57 ± 0.00
Significance	***	***	***	***	***	***	NS	NS	NS

a, b, c, d and e: means in the same column with different superscripts are significantly ($P < 0.05$) different
NS = not significant *** = ($P < 0.001$)

Feeding values of the experimental treatments presented in Table (6) revealed that the control treatment recorded the highest TDN and DE values being 61.68% and 2719.91 Kcal/kg, respectively, while 10% coffee pulp treatment showed the lowest ones being 61.19% for TDN and 2697.87 Kcal / kg for DE. The highest DCP (11.77%) was achieved by the 20% potato peel treatment and the lowest one (10.90%) was recorded by the control treatment. However, the differences in feeding values (TDN, DCP and DE Kcal/kg) due to treatment effects were not significant (Table 6).

In general, the improvement of nutrients digestibility of diets containing potato wastes may be due to exposing these materials to heating process which alter nature of the starch to be more vulnerable to amylases as well as destroying trypsin inhibitors, consequently increasing digestibility of these nutrients **(Nicholson *et al.*, 1988; Makkar *et al.*, 1984; Donald *et al.*, 1983 and Cerning-Beroard and Le Dividich, 1976).**

Digestibility of CF and EE were significantly affected by incorporation of potato processing by products meal in rabbit diets, whereas, DM, OM, CP and NFE digestibilities were not significantly affected **(Helaly *et al.*, 2002).**

Concerning the effect of dietary potato processing by-products on feeding values, **Ali *et al.* (1999)** reported that incorporation of sweet potato tops or roots in rabbit diets had significant effect on feeding values of diets, whereas, **Helaly *et al.* (2002)** found that using potato processing by-products meal had no significant effect on TDN and DE values of rabbit diets.

Gomez-Brenes *et al.* (1985) demonstrated that using ensiled coffee pulp in Wistar rats feeding improved both nutritive and digestibility values, also was less toxic than fresh pulp.

4.4. Nitrogen Balance:

Results for nitrogen balance of growing NZW rabbits as affected by dietary treatments at 13 weeks of age are shown in Table (7). The amounts of N-intake, fecal-N, urinary-N g rabbit / day were nearly similar in all groups fed on different experimental diets, with insignificant differences. The N-intake ranged between 2.64 and 2.47 g/day, fecal-N ranged between 0.77 and 0.72 g/day and urinary-N varied between 0.61 and 0.56 g/day. While the amounts of N-absorbed g/day and N-balance as g/day, % of N-intake or % of N-absorbed were significantly ($P < 0.001$) affected by dietary treatments. In general, rabbits fed on diets contained 10% or 30% potato peel showed the highest values for N-absorbed g/day, and N-balance as g/day, % of N intake and % N-absorbed, whereas, rabbits fed on diets with 10, 20 or 30% coffee pulp recorded almost the lowest values. However, the differences in N-absorbed g/day and N-balance as g/day, % of N-intake or % of N-intake between rabbits fed the control diet and those fed 20% potato peel were mostly insignificant (Table 7).

In conclusion, nitrogen balance was found to be positive in all tested diets, therefor any differences may be attributed to the differences in the nutritional quality of protein between the control diet and the diets contained potato peel and coffee pulp.

Table (7): Least square means and standard errors for nitrogen balance of growing NZW rabbits as affected by dietary treatments at 13 weeks of age.

Treatment	N-intake (g/day)	Fecal-N (g/day)	N-absorbed (g/day)	Urinary-N (g/day)	N-balance (g/day)	N-balance (% of N-intake)	N-balance (% of N-absorbed)
Control	2.53 ± 0.01	0.72 ± 0.01	1.81 ± 0.01^{b}	0.60 ± 0.009	1.21 ± 0.01^{c}	47.83 ± 0.02^{c}	66.85 ± 0.01^{c}
Potato peel							
10 %	2.64 ± 0.01	0.70 ± 0.01	1.94 ± 0.01^{a}	0.60 ± 0.009	1.34 ± 0.01^{a}	50.76 ± 0.02^{a}	69.07 ± 0.01^{a}
20 %	2.52 ± 0.01	0.72 ± 0.01	1.80 ± 0.01^{b}	0.61 ± 0.009	1.19 ± 0.01^{c}	47.22 ± 0.02^{d}	66.11 ± 0.01^{c}
30 %	2.57 ± 0.01	0.75 ± 0.01	1.85 ± 0.01^{b}	0.58 ± 0.009	1.27 ± 0.01^{b}	49.42 ± 0.02^{b}	68.65 ± 0.01^{a}
Coffee pulp							
10 %	2.56 ± 0.01	0.76 ± 0.01	1.80 ± 0.01^{b}	0.58 ± 0.009	1.22 ± 0.01^{c}	47.66 ± 0.02^{c}	67.78 ± 0.01^{b}
20 %	2.51 ± 0.01	0.77 ± 0.01	1.74 ± 0.01^{c}	0.56 ± 0.009	1.18 ± 0.01^{c}	47.01 ± 0.02^{d}	67.82 ± 0.01^{b}
30 %	2.47 ± 0.01	0.75 ± 0.01	1.72 ± 0.01^{c}	0.60 ± 0.009	1.12 ± 0.01^{d}	45.34 ± 0.02^{e}	65.12 ± 0.01^{d}
Significance	NS	NS	**	NS	**	***	***

a, b, c, d and e: means in the same column with different superscripts are significantly ($P < 0.05$) different

NS = not significant ** = ($P < 0.01$) *** = ($P < 0.001$)

Makkar *et al.* (1984) found higher urinary nitrogen with the control group compared with groups fed potato waste in the sheep, which is in partial agreement with the results obtained in the present study.

Chris *et al.* (1985) claimed that fecal nitrogen decreased significantly with 20% potato pulp wastes containing diets, but urinary nitrogen did not differ among the treatments studied.

On the other hand, **Helaly *et al.* (2002)** found no significant differences in N-balance among all tested groups of rabbits fed potato processing by-products meal.

4.5. Carcass Traits:

Least square means and standard errors for carcass traits of growing NZW rabbits at 13 weeks of age as affected by dietary treatments are presented in Table (8). Analysis of variance for carcass trait percentages (Table 8) revealed significant differences ($P < 0.001$) among dietary treatments in pre-slaughter weight, chest & loin, dressing, liver, total giblets, boneless meat and bone percentages. However, insignificant differences were detected among the experimental treatments in blood, fore-quarters, hind quarters, kidneys, heart, lungs, head, coat, full digestive tract and abdominal fat percentages. The best values for pre-slaughter weight, fore-quarters, chest & loin, hind quarters, dressing and boneless meat percentages were recorded for rabbits fed diets containing 30% potato peel. Moreover, rabbits fed diets with 20% potato peel showed the higher values for liver, total giblets and abdominal fat percentages. Whereas, rabbits fed the control diet achieved the lowest values for chest & loin, liver and total giblets percentages. Also, the lowest

Table (8): Least square means and standard errors for carcass traits (%)* of growing NZW rabbits as affected by dietary treatments at 13 weeks of age.

Treatment	Pre-slaughter wt (g)	Blood (%)	Fore-quarters (%)	Chest & loin (%)	Hind-quarters (%)	Dressing (%)	Liver (%)	Kidney (%)	Heart (%)
Control	1810.00± 19.00 ^{d}	3.50 ± 0.001	15.16 ± 0.29	16.37 ± 0.01^{c}	19.94 ± 0.01	54.95 ± 0.08^{d}	2.41 ± 0.03^{d}	0.73 ± 0.001	0.35 ± 0.002
Potato peel									
10 %	1799.25± 19.00 ^{d}	3.50 ± 0.001	14.86 ± 0.29	17.30 ± 0.01^{b}	19.74 ± 0.01	55.55 ± 0.08^{c}	2.56 ± 0.03^{c}	0.71 ± 0.001	0.34 ± 0.002
20 %	1921.50± 19.00 ^{bc}	3.20 ± 0.001	14.76 ± 0.29	18.81 ± 0.01^{a}	19.83 ± 0.01	57.17 ± 0.08^{b}	2.73 ± 0.03^{a}	0.72 ± 0.001	0.32 ± 0.002
30 %	2029.25± 19.00 ^{a}	3.10 ± 0.001	15.72 ± 0.29	19.13 ± 0.01^{a}	20.35 ± 0.01	57.98 ± 0.08^{a}	2.51 ± 0.03^{c}	0.73 ± 0.001	0.33 ± 0.002
Coffee pulp									
10 %	1799.25± 19.00 ^{d}	3.50 ± 0.001	14.86 ± 0.29	17.69 ± 0.01^{b}	19.64 ± 0.01	55.81 ± 0.08^{c}	2.62 ± 0.03^{b}	0.71 ± 0.001	0.31 ± 0.002
20 %	1869.50± 19.00 ^{c}	3.40 ± 0.001	14.75 ± 0.29	17.39 ± 0.01^{b}	19.74 ± 0.01	55.45 ± 0.08^{c}	2.53 ± 0.03^{c}	0.73 ± 0.001	0.32 ± 0.002
30 %	1949.00± 19.00 ^{b}	3.30 ± 0.001	14.65 ± 0.29	16.79 ± 0.01^{c}	19.94 ± 0.01	54.93 ± 0.08^{d}	2.51 ± 0.03^{c}	0.72 ± 0.001	0.33 ± 0.002
Significance	***	NS	NS	***	NS	***	***	NS	NS

* Carcass traits (%): calculated as g per 100 g pre-slaughter weight.

a, b, c and d: means in the same column with different superscripts are significantly ($P < 0.05$) different

NS = not significant *** = ($P < 0.001$)

Table (8) Cont.: Least square means and standard errors for carcass traits (%)* of growing NZW rabbits as affected by dietary treatments at 13 weeks of age.

Treatment	Total giblets (%)	Lungs (%)	Head (%)	Coat (%)	Full digest. tract (%)	Abdominal fat (%)	Boneless meat** (%)	Bone** (%)
Control	3.49 ± 0.01^{d}	0.74 ± 0.03	5.68 ± 0.28	15.87 ± 0.01	15.87 ± 0.01	0.56 ± 0.03	83.87 ± 0.01^{c}	16.42 ± 0.05^{b}
Potato peel								
10 %	3.68 ± 0.01^{b}	0.75 ± 0.03	5.58 ± 0.28	15.77 ± 0.01	15.26 ± 0.01	0.60 ± 0.03	83.57 ± 0.01^{c}	16.44 ± 0.05^{b}
20 %	3.77 ± 0.01^{a}	0.70 ± 0.03	5.24 ± 0.28	15.26 ± 0.01	15.16 ± 0.01	0.61 ± 0.03	84.96 ± 0.01^{b}	15.05 ± 0.05^{c}
30 %	3.56 ± 0.01^{c}	0.70 ± 0.03	5.47 ± 0.28	15.46 ± 0.01	15.58 ± 0.01	0.58 ± 0.03	86.10 ± 0.01^{a}	13.78 ± 0.05^{d}
Coffee pulp								
10 %	3.64 ± 0.01^{b}	0.70 ± 0.03	5.50 ± 0.28	15.36 ± 0.01	15.80 ± 0.01	0.56 ± 0.03	83.80 ± 0.01^{c}	16.21 ± 0.05^{b}
20 %	3.57 ± 0.01^{c}	0.77 ± 0.03	5.53 ± 0.28	15.27 ± 0.01	15.20 ± 0.01	0.61 ± 0.03	83.91 ± 0.01^{c}	16.11 ± 0.05^{b}
30 %	3.57 ± 0.01^{c}	0.73 ± 0.03	5.43 ± 0.28	15.66 ± 0.01	15.50 ± 0.01	0.56 ± 0.03	82.42 ± 0.01^{d}	17.60 ± 0.05^{a}
Significance	***	NS	NS	NS	NS	NS	***	***

* Carcass traits (%): calculated as g per 100 g pre-slaughter weight.

** Calculated as % from dressed weight.

a, b, c and d : means in the same column with different superscripts are significantly ($P < 0.05$) different

NS = not significant *** = ($P < 0.001$)

values for fore-quarters, dressing and boneless meat percentages were recorded for rabbits fed 30% dietary coffee pulp. Moreover, rabbits fed 10% coffee pulp showed the lowest hind-quarters percentage and pre-slaughter weight.

Generally, it seems that feeding rabbits on diets containing different levels of potato peel slightly improved most carcass traits percentages as compared with the other experimental treatments. Also, percentages of most carcass traits for rabbits fed different dietary coffee pulp levels were similar or slightly better than those of the control group.

In this concern, many reports showed that feeding growing rabbits on some agricultural by-products had no negative effect on carcass traits, **Zeweil (1992 a & b)** using artichoke canning by-products and pea processing, **Soliman (1995)** using dried sweet potato tops hay, **Abd El-Lateif (1996)** with beet tops, **El-Meligy (1996)** with dried whole plant of turnips and **Tag El-Din *et al.* (2000)** using sugar beet tops. Also, **Helaly *et al.* (2002)** found insignificant differences between the control group and other groups of NZW rabbits fed potato processing by-products meal and discarded sweet potato tubers meal in dressing percentage, liver and total edible parts. Similarly, **Donkoh *et al.* (1988)** indicated that all carcass traits, with the exception of dressing percentage, were similar due to using diets containing dried coffee pulp in commercial broiler chickens.

4.6. Chemical Analysis Of Boneless Meat:

Chemical analysis of boneless meat of growing NZW rabbits as affected by dietary treatments at 13 weeks of age are

shown in Table (9). Analysis of variance revealed that dietary treatments had no significant effect on chemical analysis of boneless meat of rabbits (Table 9). The highest moisture percentage (68.75) was shown by rabbits fed 30% dietary potato peel, while the lowest percentage (66.75) was achieved by rabbits fed either 20% dietary potato peel or 20% dietary coffee pulp. Rabbits of 20% potato peel and 10% coffee pulp treatments showed the highest EE percentage (6.73), while those of 30% coffee pulp treatment represented the lowest content (6.50%). The highest percentage for CP (23.25) was recorded for rabbits fed 10% dietary coffee pulp and the lowest % (21.50) was shown for rabbits fed diet with 20% potato peel or the control. However, rabbits fed the control diet achieved the highest ash percentage (2.26) and those fed 30% potato peel represented the lowest % (2.12).

Values of chemical analysis of boneless meat obtained in the present study are within the ranges reported by **Abdel Magid (1997), El-Ayouty *et al.* (2000), Abd El-Galil and Khider (2001) and Khashba *et al.* (2002)** for the chemical analysis of NZW rabbits meat fed on different agro-industrial by-products. They added that the differences in chemical analysis due to feeding treatments were almost non-significant.

Table (9): Least square means and standard errors for chemical analysis of boneless meat of growing NZW rabbits as affected by dietary treatments at 13 weeks of age.

Treatment	Moisture	EE	CP	Ash
Control	68.00 ± 1.68	6.55 ± 0.63	21.50 ± 0.65	2.26 ± 0.01
Potato peel				
10%	68.00 ± 1.68	6.70 ± 0.56	22.75 ± 0.85	2.20 ± 0.01
20%	66.75 ± 1.37	6.73 ± 0.56	21.50 ± 0.65	2.17 ± 0.01
30%	68.75 ± 1.11	6.66 ± 0.74	22.25 ± 0.85	2.12 ± 0.01
Coffee pulp				
10%	68.25 ± 0.85	6.73 ± 0.65	23.25 ± 0.85	2.18 ± 0.01
20%	66.75 ± 0.85	6.53 ± 0.62	22.50 ± 0.65	2.13 ± 0.01
30%	67.75 ± 0.85	6.50 ± 0.64	21.75 ± 0.85	2.25 ± 0.01
Significance	NS	NS	NS	NS

NS = not significant

4.7. Biochemical Blood Plasma Parameters:

Blood plasma constituents of growing NZW rabbits at 13 weeks of age as affected by dietary treatments are illustrated in Table (10). Analysis of variance for results obtained (Table 10) showed that the differences in plasma levels of all biochemical parameters due to treatments effect were significant ($P < 0.01$ and $P < 0.001$) except alkaline phosphatase level.

Table (10): Least square means and standard errors for biochemical blood plasma parameters of growing NZW rabbits as affected by dietary treatments at 13 weeks of age.

Treatment	Total protein (g/dl)	Albumin (g/dl)	Globulin (g/dl)	A/G ratio	Total lipids	GOT	GPT	Glucose	Alk. Phos.	Cholest.	Creatin.
Control	5.43 ± 0.01^{d}	2.74 ± 0.01^{d}	2.68 ± 0.01^{e}	1.02 ± 0.02^{d}	288.07 ± 0.01^{e}	44.22 ± 0.01^{e}	24.14 ± 0.03^{a}	89.17 ± 0.01^{e}	55.12 ± 0.94	89.20 ± 0.01^{g}	1.28 ± 0.01^{a}
Potato peel											
10 %	7.33 ± 0.01^{a}	4.42 ± 0.01^{a}	2.91 ± 0.01^{a}	1.52 ± 0.02^{a}	320.46 ± 0.01^{a}	49.67 ± 0.01^{a}	22.77 ± 0.03^{c}	91.54 ± 0.01^{a}	54.27 ± 0.94	96.97 ± 0.01^{c}	1.24 ± 0.01^{b}
20 %	7.19 ± 0.01^{a}	4.34 ± 0.01^{a}	2.85 ± 0.01^{b}	1.52 ± 0.02^{a}	316.85 ± 0.01^{b}	49.64 ± 0.01^{a}	22.42 ± 0.03^{d}	89.32 ± 0.01^{d}	53.35 ± 0.94	92.33 ± 0.01^{d}	1.19 ± 0.01^{c}
30 %	7.25 ± 0.01^{a}	4.43 ± 0.01^{a}	2.82 ± 0.01^{b}	1.57 ± 0.02^{a}	310.65 ± 0.01^{c}	49.17 ± 0.01^{b}	22.25 ± 0.03^{d}	89.56 ± 0.01^{c}	53.57 ± 0.94	90.24 ± 0.01^{f}	1.26 ± 0.01^{a}
Coffee pulp											
10 %	6.12 ± 0.01^{b}	3.38 ± 0.01^{b}	2.74 ± 0.01^{d}	1.22 ± 0.02^{b}	297.46 ± 0.01^{d}	48.15 ± 0.01^{c}	22.88 ± 0.03^{c}	89.37 ± 0.01^{d}	54.20 ± 0.94	108.84 ± 0.01^{a}	1.24 ± 0.01^{b}
20 %	5.84 ± 0.01^{c}	3.06 ± 0.01^{c}	2.78 ± 0.01^{c}	1.10 ± 0.02^{c}	295.65 ± 0.01^{d}	47.39 ± 0.01^{d}	23.21 ± 0.03^{b}	88.68 ± 0.01^{f}	54.50 ± 0.94	102.65 ± 0.01^{b}	1.18 ± 0.01^{c}
30 %	5.65 ± 0.01^{c}	2.93 ± 0.01^{c}	2.72 ± 0.01^{d}	1.08 ± 0.02^{c}	291.08 ± 0.01^{e}	46.06 ± 0.01^{d}	21.66 ± 0.03^{e}	90.71 ± 0.01^{b}	53.45 ± 0.94	91.27 ± 0.01^{e}	1.26 ± 0.01^{a}
Mean	6.40	3.61	2.79	1.29	302.89	47.76	22.76	89.77	54.07	95.93	1.24
Significance	***	***	***	**	**	**	**	***	NS	**	***

a, b, c, d, e, f and g: means in the same column with different superscripts are significantly ($P < 0.05$) different
NS = not significant ** = ($P < 0.01$) *** = ($P < 0.001$)

Results in Table (10) cleared that rabbits fed the control diet showed the highest GPT, alkaline phosphatase and creatinine levels and the lowest values for all other blood plasma constituents tested.

The highest values for total protein, globulin, total lipids, GOT and glucose were recorded by rabbits fed 10% potato peel, and the highest levels for albumin and A/G ratio were shown by rabbits fed 30% potato peel. Moreover, rabbits of 10% coffee pulp treatment achieved the highest cholesterol level. Whereas, rabbits fed 30% potato peel, 20% coffee pulp and 30% coffee pulp recorded the lowest cholesterol, glucose and GPT levels, respectively. In general, rabbits fed different levels of potato peel showed almost higher levels for most blood plasma constituents than other experimental groups.

The mean total plasma protein value in the present study (6.40 g/dl) is higher than that reported by **Gad Alla (1999)** being 5.98 g/dl for rabbits fed different agricultural wastes, but lower than that reported by **El-Sayaad *et al.* (1996),** 7.83 g/dl for NZW rabbits fed different CF levels and **Abdel-Magid (2005),** 7.09 g/dl for NZW rabbits fed different leguminous straw. Mean plasma albumin value in this study (3.61 g/dl) is very close to that reported by **Gad Alla (1999),** 3.74 g/dl and **Abdel-Magid (2005)**, 3.72 g/dl for NZW rabbits, but was higher than that reported by **El-Sayed *et al.* (1999),** 3.20 g/dl. Concerning plasma globulin values, the mean value in the present study (2.79 g/dl) is higher than that reported by **Gad Alla (1999)**, 2.22 g/dl and **El-Sayed *et al.* (1999)** 2.64 g/dl, but lower than that reported by **El-Sayaad *et al.* (1995), Mohamed(1999)**and **Abdel-Magid (2005)**

being 3.94, 3.31 and 3.37 g/dl, respectively. The mean value of A/G ratio (1.29) is very close to that reported by **Mohamed (1999)**, **El-Sayed *et al.* (1999) and Abdel-Magid (2005)** being 1.28, 1.23 and 1.11 g/dl, respectively, but higher than that reported by **El-Sayaad *et al.* (1995)** which was 0.70 and lower than that reported by **Gad Alla (1999)** being 1.69 g/dl.

Average values of GOT and GPT (47.76 and 22.76 u/L, respectively) are higher than those reported by **Tag El-Din *et al.* (2000)** being 21.00 and 12.88 U/L, and **Abdel-Magid (2005)** being 21.5 and 14.2 U/L, respectively. Plasma alkaline phosphatase activity (54.07 U/L) is higher than that reported by **Abdel-Magid (1997) and (2005)** being 42.2 and 41.1 U/L, respectively.

The mean value of cholesterol (95.93 mg/dl) is nearly similar to that reported by **El-Sayed *et al.* (1999)** being 95.94 mg/dl. but higher than that reported by **El-Gindy *et al.* (2002), Tag El-Din *et al.* (2000) and Abdel-Magid (2005)** being 70.1, 69.5 and 79.0 mg/dl, respectively.

Results of the present study showed that total lipids and cholesterol levels increased ($P < 0.05$) as the level of either dietary potato peel or coffee pulp increased. Reversible results were obtained by **Azouz (1994)** whereas the levels of total lipids and total cholesterol declined significantly in blood serum of rabbits fed diets including 5% olive pulp compared with those fed the control diet.

Mousa and Abd El-Samee (2002) revealed significant ($P < 0.05$) differences in serum total protein, albumin and cholesterol concentrations due to the effect of feeding rabbits, on

olive pulp. Whereas, **Okai and Dabo (1991)** claimed that replacing wheat bran with 0, 10, 20 and 30% dried coffee pulp in the diet of Large White pigs had no significant effect on blood glucose, protein and cholesterol levels. Also, **Khashaba *et al.* (2002)** revealed no significant differences in blood serum cholesterol of growing rabbits fed on pea and dried citrus pulp by-products.

4.8. Economic Efficiency:

Average feed cost / kg WG and economic efficiency (EEf) for the experimental diets used during the feeding period are presented in Table (11). Calculation of the values was based upon the prevailing market prices for feed ingredients of the experimental diets used during the experimental period in 2001. Values of feed cost / kg WG showed that the diet contained 30% potato peel recorded the highest value (298.58 PT), whereas the diet contained 10% potato peel showed the lowest one (259.70 PT). However, the incorporation of different levels of potato peel or coffee pulp in the rabbit diets decreased the feed cost / kg WG as compared with the control except for 30% dietary potato peel level.

Data in Table (11) showed that diets recorded the lowest feed cost / Kg WG values, achieved the highest (best) EEf values. Therefore, the diet contained 10% potato peel recorded the best EEf value (208.09) and that with 30% potato peel showed the poorest one (167.97). However, it is clear that EEf values decreased with increasing the dietary level of either potato peel or coffee pulp. Considering the EEf value of the control diet equals 100, the relative EEf values were 121.94,

Table (11): Average feed cost / kg weight gain and economic feed efficiency of the experimental diets used during the experimental period (5-13 weeks of age).

Item	Control	Potato peel			Coffee pulp		
		10%	20%	30%	10%	20%	30%
Average daily FI, as fed, g/rabbit	114.07	133.13	129.13	127.00	131.13	129.13	125.13
Price of 1 Kg FI (PT)[1]	60.85	52.30	52.40	54.60	52.85	50.40	52.50
Cost of feed consumed (PT)	6.94	6.96	6.77	6.93	6.93	6.51	6.57
Average daily WG (g).	23.48	26.80	24.75	23.21	25.71	24.01	22.35
Price of 1 Kg LBW (PT) [2]	800	800	800	800	800	800	800
Feed cost / Kg WG (PI)	295.57	259.70	273.53	298.58	269.54	271.14	293.96
Total revenue (PT)	18.78	21.44	19.80	18.57	20.57	19.21	17.88
Net revenue (PT)	11.84	14.48	13.03	11.64	13.64	12.70	11.31
Economic feed efficiency % [3]	170.61	208.05	192.47	167.97	196.82	195.08	172.15
Relative economic feed efficiency	100	121.94	112.81	98.45	115.36	114.34	100.90

(1) Based on the price of different ingredients in the market during the experimental period.

(2) Based on the price of 1 kg rabbit LBW in the local market during the experimental period.

(3) Economic feed efficiency % = $\frac{\text{Net revenue}}{\text{Cost of feed consumed}} \times 100$.

112.81 and 98.45 for diets contained 10, 20 and 30% potato peel and 115.36, 114.34 and

100.90 for those contained 10, 20 and 30% coffee pulp, respectively, indicating the previous trend observed with EEf values.

The previous results are in harmony with those reported by **Helaly *et al.* (2002)** who found that incorporation of potato processing by-products meal and discarded sweet potato tubers meal in growing rabbits diets increased (improved) EEf from 5.7 to 13.2% above the control. Similarly, **Tag El-Din *et al.* (1999)** found that the feed cost / kg WG and EEf of rabbits fed the control diet and those given 20% corn stalk were nearly similar and both were significantly ($P < 0.01$) better that of rabbits feed 10 and 30% corn stalk.