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RESPONSE OF GROWING RABBITS TO DIETS CONTAINING DFFERENT LEVELS OF ENERGY AND VITAMIN C.

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SUMMARY

This work was carried out to evaluate the alleviation ability of vitamin C on the decrease of energy in rabbit's diet. A total number of sixty males and females weanling New Zealand White rabbits at six week old were used to study the effect of two different levels of energy supplemented with or without vitamin C. Rabbits were classified into five equal groups and the experimental period extended for eight weeks. The group one (control) was fed the basal diet 2824 Kcal digestible energy/Kg, groups 2 and 4 received 2729 and 2633 Kcal digestible energy/kg diet, respectively while, the groups 3 and 5 received 2729 and 2633 Kcal /kg diet supplemented with 500 ppm vitamin C. Growth performance, digestibility of nutrients, carcass traits, some blood constituent, the total count of bacteria and yeast in caecum and total fungi isolated from stored feed in different temperature (30 and 35° C) and relative humidity were studied. The results indicated that body weight and weight gain at different periods significantly lower by rabbits fed low energy levels but it tends to improve with adding vitamin C. Feed intake increase significantly with rabbits fed low energy. The best fed conversion was recorded by rabbits fed 2729 Kcal digestible energy/Kg with vitamin C. Rabbits fed low energy level significantly ($P<0.05$) improve the digestibility coefficient of DM and NFE but CP and TDN significantly decreased. There was no significant effect on carcass traits for rabbits fed different treatments. Rabbits fed low energy level 2633 kcal digestible energy with vitamin C had a significant ($P<0.05$) decrease in cholesterol, triglycerides and glucose. There were no significant effect on total count of bacteria and yeasts in caecum when rabbits fed different diet. On the other hand, there was a significant effect on total fungi isolated from rabbits feed when stored at different temperature (30 and 35° C) and relative humidity (71 &87%) for 30 days. It could be concluded from the results of this study that growing rabbits could be fed 2729 Kcal/ kg with 500mg/kg vitamin C realize the best values of growth performance, some digestibility coefficients, and immune response. Total revenue was also improved.

Keywords: *rabbits; energy levels; vitamin C; growth performance; digestibility; blood parameters; fungi; stored feed; economic efficiency.*

INTRODUCTION

Feed is one of the most important cost factors in poultry production and energy represents the largest fraction of this cost. Surprisingly little is known about the energy utilization in rabbits. NRC (1977) recommended 10.46MJ per kg digestible energy for high meat production in temperate climate, but owing to high ambient temperatures which cause depression in feed intake, livestock and poultry in the tropics may have requirements different from the level recommended for similar animals in temperate climate. Obinne (2008) found that a diet containing digestible energy level of 8.7 MJ/kg in combination with 16% protein was adequate for the optimum growth of rabbits in the tropics. Ibrahim *et al.* (2009) regardless to the energy level, the supplementation of herbs mixture used at 1% significantly ($P<0.05$) improved DM, OM, CF, NFE and TDN digestibility values compared to the control group, while DCP value significantly ($P<0.05$)decreased compared to the control group. These improvements in the digestion values may be due to the increased gastrointestinal transit time induced by *Artemisia herbaalba* and / or may be due to the antimicrobial activities of *Matricaria chamomilla L* .as well as may be due to the high content of ascorbic acid and carotenoids in *Chrysanthemum coronarium* that may be useful in preventing vascular weakness. El-Hindawy *et al.* (1993) showed that feeding rabbits high level of energy (2800 kcal digestible energy/kg) was significantly ($P<0.05$) had the highest value of live body weight, daily weight gain, feed conversion, nutrients digestibility coefficients and most of carcass traits as compared as to other levels of energy (2600 and 2400 kcal digestible energy). Omer *et al.* (2012) showed that decreasing energy requirements by 10% in rabbit diets significantly ($P<0.05$) increased the digestibility coefficients of DM, OM, CP and NFE & DCP values. Several researchers observed significant improvement in growth of chicks by the addition of vitamin C under high temperature. Broilers fed diets containing vitamin C were less stressed due to having reduced body temperature and respiratory rates (Pardue and Thaxton, 1986) and showed higher feed intake (Mckee and Harrison.1995) than control birds. Substantial available reports show under field conditions that feeding vitamin C enhanced productivity, immune response, disease resistance, and survivability under stressful conditions (Zulkifli *et. al.*, 1996). Supplementation of vitamin C and vitamin E in the layer diets is suggested because of their ant-stress effects (Gonjalez-Vega *et al.*, 1995).

Many studies have shown that antioxidant vitamins like vitamin C and E can prevent atherosclerosis by preventing LDL oxidation. Vitamin C always forms the first line of antioxidant defense and is the only antioxidant in plasma that can completely prevent lipid per oxidation (Gholmreza *et al.*, 2007). Kutlu and Forbes (1993) reported that ascorbic acid reduces the synthesis of corticosteroid hormones in birds by decreasing synthesis and secretion of corticosteroids, vitamin C alleviates the negative effects of stress such as hot stress related depression in poultry performance (McDowell, 2000).

This work aimed to evaluate the efficacy of ascorbic acid as feed additives in improving the utilization of low energy in rabbit's diet.

MATERIALS AND METHODS

This study was carried out at Poultry Production, Faculty of Agriculture, Ain Shams University. Sixty males and females weaned New Zealand White rabbits at six week old were allotted to five experimental groups and the experimental period extended for eight weeks. The group one (control) received 2824 Kcal digestible energy/Kg , groups 2 and 4 received 2729 and 2633 Kcal digestible energy /kg diet, respectively while, the groups 3 and 5 received 2729 and 2633 Kcal digestible energy /kg diet supplemented with 500 ppm vitamin C. All experimental diets were formulated to meet the recommended nutrient requirements of rabbits according to NRC (1977) and Lebas *et al.* (1986). Ingredients and calculated nutrient content of the experimental diets are shown in Table (1).

The rabbits were housed in galvanized metal wire cages provided with feeders and automatic drinking system and were kept under the same managerial and hygienic conditions. Live body weight of rabbits and feed consumption were biweekly recorded. Feed conversion ratio was calculated as (g feed/g gain).

Digestibility trial was carried out at the end of the growth experiment using three male rabbits per diet to determine the apparent digestibility of nutrients and nutritive value of the experimental diets. Rabbits were housed individually in metabolic cages, which allowed separation of feces and urine. Feces were collected individually during five consecutive days.

The chemical analysis of diets and feces for DM, EE, CP, CF, NFE, and ash were conducted according to AOAC (1996).

The total digestible nutrients (TDN) were calculated according to the classic formula (Cheeke *et al.*, 1982) as following:

TDN= DCP+DCF+DNFE+ (DEE*2.25).

Where: DCP= Digestible Crude Protein, DEE=Digestible Ether Extract, DCF=Digestible Crude Fiber.

At the end of the experimental period, three representative rabbits from each treatment were randomly chosen and fasted for 12 hours before slaughtering according to Blasco *et al.* (1993) and also determining the carcass traits and plasma parameters.

After complete bleeding of rabbits, pelt, viscera and tail were removed carcass and giblets (liver, heart, and kidney) were weighed. Dressing percentage included relative weights of carcass, giblets and head.

Blood samples were collected at slaughtering into heparinized tubes. A drop of blood from each sample was used to make smears for using slides stained with Wrights' stain and neutrophils

/lymphocytes ratio (N/L) was measured. Blood samples were centrifuged at 4000 r.p.m. for 20 minutes for preparation of blood plasma. The collected plasma was stored at -20° C until assay.

Blood plasma contents of glucose, total protein, albumin, cholesterol and activities of aspartate aminotransferase (AST) and alanine aminotransferase (ALT) were measured using commercial kits (Vitro Scient Company). The total globulin values were calculated by subtracting the values of total albumin from the values of total protein for each sample. Total protein was determined according to (Peters, 1986), albumin according to Doumas *et al.* (1971), total cholesterol according to Pisani *et al.* (1995), triglycerides according to Greiling and Gressner (1995), glucose according to Trinder (1969) and activities of AST and ALT according to Harold (1975).

Table (1): The composition of dietary treatments and calculated nutrient content of the experimental diets.

	Experimental diets				
Ingredients	Control	Group2	Group3	Group4	Group5
Alfalfa hay	29	26.5	26.5	29.1	29.1
Yellow corn	25	17.7	17.7	12.5	12.5
Wheat bran	27	38.5	38.5	41.1	41.1
Soybean meal (44%)	14.2	12.5	12.5	12.5	12.5
Ascorbic acid (ppm)	-	-	500	-	500
Molasses	3	3	3	3	3
Salt	0.5	0.5	0.5	0.5	0.5
Limestone	0.95	1.02	1.02	1.0	1.0
Vitamin and mineral premix*	0.35	0.28	0.28	0.3	0.3
Total	100	100	100	100	100
*Calculated nutrient content***					
Digestible energy (Kcal/Kg)	2824	2729	2729	2633	2633
Crude protein	17.8	17.75	17.75	17.76	17.76
Crude fiber	11.32	11.65	11.65	12.42	12.42
Ether extract	2.94	3.01	3.01	3.03	3.03
Ca	0.86	0.75	0.75	0.85	0.85
P	0.57	0.68	0.68	0.69	0.69

Each 2.5 kg of vitamins and minerals mixture contain: 12.000.000 IU vitamin A acetate; 2000.000 IU vitamin D3; 10.000mg vitamin E acetate; 2000 mg vitamin k3; 100 mg vitamin B1; 4000 mg vitamin B2; 1500 mg vitamin B6; 10 mg vitamin B12 ; 10.000 mg Pantothenic acid ; 20.000 mg Nicotinic acid ; 1000 mg folic acid ; 50 mg biotin ; 500.000 mg Chorine ; 10.000 mg Iodine ; 300.000 mg Iron ; 55.000 mg Manganese ; 55.000 mg Zinc, and 100 mg Selenium.

***Calculated according to Lebas et al. (1986).*

Microbiological analysis:

The total count of bacteria and yeasts of the caecum of the slaughtered rabbits (3 rabbits/ treatment) was estimated. Total count of bacteria and yeasts had been determined using nutrient agar medium and Sabaroud agar medium respectively as described by Oxoid (1952).

The total content of fungi was estimated in storage feed for 30 days at 30°C and 35°C under two different relative humidity degrees (71 and 87 %) which were adjusted in humidity chambers. Winston and Bates (1960) reported a design was based for stabilizing different required relative humidity; the design was based on creating a constant relative humidity at certain saturated salt solution in sealed desiccators. Saturated solution of (NaCl and KCl) and Na_2CO_3. 10 H_2O prepared to give 71 % and 87 % at 30°C respectively while saturated solution of $NaNo_3$ and Na_2So_4. $10H_2O$ gave 71 % and 87 %, relative humidity at 35°C respectively. Method of Allen (1959) was used for fungi counts.

Economic efficiency (%) of experimental diets was calculated according to the local market price of ingredients and rabbit live body weight as:

Net revenue = Total revenue – Total feed cost.

Economic efficiency (%) = Net revenue / Total feed cost %.

Growth performance index was calculated according to the equation described by North (1981) as follows:

Performance index = Live body weight (kg) / feed conversion X 100.

Statistical analyses:

The data obtained were subjected to analysis of variance according to SPSS (1997). Significant differences among individual means were analyzed by Duncan's multiple range test (Duncan, 1955).

RESULTS AND DISCUSSION

Growth performance and feed conversion:

Data of Table (2) showed the weight and weight gain of rabbits fed on pellets contained two levels of energy (2729 and 2633 kcal digestible energy/kg) and/or combination with ascorbic acid (500 ppm). Rabbits fed low energy 2633 kcal digestible energy/ kg without vitamin C decreased body weight significantly (P<0.05). Rabbits fed 2729 kcal digestible energy/ kg with vitamin C improved body weight at 10 – 12 weeks and 12 -14 weeks. Weight gain decrease at 6-8 weeks with rabbits fed low energy level but it tends to improve significantly with adding vitamin C. At 8-10 weeks weight gain decreased significantly (336.67g) with rabbits fed low energy 2633 kcal digestible energy/kg without vitamin C. Rabbits fed 2729 kcal digestible energy/kg with vitamin C at 10-12 weeks improve significantly comparing with other treatments. At 12 -14 weeks weight gain decrease significantly with rabbits fed 2633 kcal digestible energy/kg but it tends to improve with adding vitamin C. The low levels of energy due to decrease feed intake significantly compared to control at 6-8 weeks. Feed intake decrease significantly (P<0.05) with rabbits fed the lowest level of energy at period 8-10 and 12-14 weeks. In periods 10-12 weeks, feed intake improve when rabbits fed low energy level with vitamin C. Different levels of energy with or without vitamin C were not significantly effect on rabbits feed conversion at 6-8 and 8-10 weeks. At 12-14 weeks, feed conversion decreased significantly with low energy levels compared to control but it improve significantly with adding vitamin C.

Similar results observed by El- Hindawy *et al.* (1993) they reported that the rabbit fed high level of energy 2800 kcal digestible energy/kg was significantly the highest values of live weight, daily gain weight and feed conversion as compared to other levels of energy from 5 to 12 weeks. Takenaka *et al.* (2000) who reported that the antioxidants properties of *Chrysanthemum coronarium L.* by reducing aflatoxin production and that may be due to caffeic acid. And / or may be due to the antihyperglycemic effect of *Matricaria chamomilla L.* that promote the great useful of energy. The improvement in digestibility by vitamin C was agreement with those obtained in rats by Abd El–Mageed (1987).These results may be due to biological role of vitamin C in digestive enzyme biosynthesis and activation.

Carcass traits:

Data in Table (3) show that rabbits fed different levels of energy with or without vitamin C had no significant difference in the weight of body, carcass %, head%, kidney%, heart% and dressing % compared with control. But liver % increase significantly with rabbits fed 2729 Kcal digestible energy/Kg and 500mg vitamin C. Ayyat (1991) results of carcass trails and chemical analysis of meat show that the different dietary energy levels (2707, 2436 and 2276 kcal digestible energy/kg) did not affect these traits (P< 0.05).

Digestibility Coefficients:

Table (4) clear that rabbits fed low energy level significantly (P<0.05) improved the digestibility coefficient of DM and NFE but CP and TDN significantly decrease. Different treatments hadn't significant effect on digestibility of OM, CF and EE. Ayyat (1991). The digestibility of nutrients didn't differ significantly among the three dietary energy level (2707, 2436 and 2276 Kcal digestible energy/Kg) fed to rabbits. Recently, Omer, *et. al.* (2012) showed that decreasing energy requirements by 10% in rabbit diets significantly (P<0.05) increased the digestibility coefficients of DM, OM, CP and NFE & DCP values.

Blood parameters:

In the present study, Table (5) show that rabbits fed low energy level 2633 kcal digestible energy/kg with vitamin C had a significant (P<0.05) decrease in cholesterol, triglyceride and glucose. Serum AST, ALT, total protein, albumin and globulin didn't significantly affect by rabbits fed different treatments. N/L ratio decreased significantly with rabbit fed energy 2729 and 2633 kcal digestible energy/kg and increase significantly with adding vitamin C. An in vitro study done by (Dos *et al.*, 2005) showed that vitamin C has different effects in moderation of blood lipoproteins. These results agree with El–Medany (2008) who reported that plasma glucose level was significantly depressed when hens were fed diets supplemented with vitamin C alone or combined with Cr. It was hypothesized that increased glucose uptake should increase oxidation of glucose which would be otherwise converted to fatty acids and stored as triglycerides in adipose tissues. Because the experimental birds were reared under summer season of Egypt (32° C), this stress may stimulate the hypothalamic – pituitary – adrenal axis to increase the secretion of glucocorticoids (corticosterone) from the adrenal cortex which in turn increase glucogensis. Dietary vitamin C may reverse the previous changes by reducing the secretion of corticosterone (Kutlu and forbes, 1993; Lein *et. al.*, 1999). But Ayyat (1991) showed that serum total lipids, cholesterol and creatinin concentrations were not affected due to the three studied energy levels (high, medium and low) with rabbits.

Table (2): Effect of addition vitamin C to different energy diets on rabbit's performance (Means ±S.D.)

Treatments	Control	Group2	Group3	Group4	Group5
Live body weight (g/rabbit)					
6 weeks	817± 7.69	812.08±19.14	816.16±11.3	802±13.84	806.66±14.37
6-8 weeks	1265.23^{a} ±24.21	1190.83^{ab} ±38.8	1255.83^{a} ±20.8	1155.83^{b} ±29.8	1156.25^{b} ±23.8
8-10 weeks	1683.75^{a} ±37.23	1572.92^{ab} ±58.4	1641.3^{abc}±36.4	1492.5^{c} ±40.1	1528.33^{bc} ±31
10-12 weeks	1976.25^{ab} ±41.9	1883.33^{bc} ±70.3	2034.17^{a} ±36.7	1796.67^{c} ±44.2	1868.3^{bc} ±37.6
12-14 weeks	2284.17^{a} ±53.91	2057.5^{ab} ±88.9	2358.33^{a} ±33.2	1897.9^{b}±60.7	2184.6^{ab} ±34.2
Weight gain (g/rabbit					
6-8 weeks	448.33^{a} ±24.26	378.75^{b} ±22.06	439.17^{a} ±13.38	353.33^{b} ±24.09	349.58^{b} ±15.16
8-10 weeks	417.92^{a} ±18.64	382.08^{ab} ±24.31	385.42^{ab} ±19.2	336.67^{b} ±32.99	372.08^{ab} ±18.3
10-12 weeks	292.5^{b} ±21.47	310.42^{b} ±19.07	392.92^{a} ±15.07	304.17^{b}±14.33	340^{b} ±16.17
12-14 weeks	307.92^{a}±21.48	174.17^{b}±46.5	324.17^{a}±18.93	101.25^{c}±53.89	316.25^{a}±14.95
Total gain	1466.67^{a} ±53.47	1245.4^{ab} ±77.1	1541.67^{a} ±26.7	1095.4^{b}±60.6	1377.9^{ab} ±23.1
Gain/day	26.19^{a} ±0.95	22.24^{ab} ±3.16	27.53^{a} ±0.48	19.56^{b} ±2.83	24.61^{ab} ±0.41
Total feed intake (g/rabbit)					
6-8 weeks	1274.58^{a} ±25.67	1092.08^{c} ±33.44	1194.58^{b}±20.7	919.14^{d} ±34.4	980.42^{d}±24.09
8-10 weeks	1222.08^{a} ±21.98	1241.67^{a} ±52.02	1210.83^{a} ±25.4	1070^{b} ±25	1105.8^{b}±22.37
10-12 weeks	1202.5^{c} ±30.43	1211.67^{c} ±31.52	1303.75^{b}±24.0	1108.33^{c} ±17.5	2184.58^{a} ±34.1
12-14 weeks	1261.25^{ab} ±37.02	1232.08^{ab} ±36.6	1335.8^{a} ±19.5	1156.6^{b} ±15.8	1201.3^{ab} ±14.3
Total intake	4960.4^{b} ±102.97	4777.5^{b} ±131.02	5045^{b} ±51.81	4255^{c} ±79.79	5472.08^{a} ±61.3
Intake/day	88.58^{b} ±1.84	85.13^{b} ±2.34	90.09^{b} ±0.93	75.98^{c} ±1.42	97.72^{a} ±1.1
Feed conversion (g feed/g gain)					
6-8 weeks	2.84±0.118	2.88±0.091	2.72±0.07	2.6±0.065	2.8±0.068
8-10 weeks	2.92±0.019	3.25±0.o27	3.14±0.032	3.18±0.064	2.97±0.046
10-12 weeks	4.11^{a}±0.082	3.9^{a}±0.025	3.32^{a}±0.067	3.64^{a}±0.032	6.43^{b}±0.014
12-14 weeks	4.09^{a}±0.054	7.07^{b}±0.085	4.12^{a}±0.087	11.42^{c}±0.02	3.8^{a}±0.052
Total feed conversion	3.38±0.009	3.84±0.92	3.27±0.003	3.89±0.89	3.97±0.003

Within rows, means with different letters differ significantly (P<0.05)

Table (3): Effect of addition vitamin C with different energy levels in rabbit's diet on carcass % (Means ± S.D.)

	Treatments				
Item	control	Group2	Group3	Group4	Group5
Body weight	2173.33±124.14	2226.67±184.06	2140±35.12	1953.33±158.4	2046.67±72.19
Carcass %	48.43±0.59	48.84±0.69	42.24±6.17	48.29±0.6	46.35±1.48
Head %	5.77±0.33	5.87±0.22	5.61±0.27	5.55±0.15	5.86±0.12
Liver %	2.48^{b} ±0.21	3.07^{ab} ±0.12	3.47^{a} ±0.21	2.78^{ab} ±0.11	3.04^{ab} ±0.31
Kidney %	0.55±0.04	0.63±0.05	0.53±0.05	0.62±0.04	0.7±0.08
Spleen %	0.06^{b} ±0.02	0.06^{b} ±0.007	0.03^{c}±0.003	0.07^{b} ±0.001	0.09^{a} ±0.003
Heart %	0.24±0.01	0.26±0.03	0.25±0.02	0.25±0.01	0.27±0.007
Dressing %	51.7±0.06	52.79±0.64	46.5±5.98	51.94±0.15	50.36±1.34

Within rows, means with different letters differ significantly (P<0.05)

Table (4): Effect of addition vitamin C to different dietary energy level on rabbit's digestibility traits (Means ± S.D.)

	Treatments				
Digestibility%	control	Group2	Group3	Group4	Group5
DM	52.6^{b}±1.74	54.5^{b}±1.02	54.1^{b}±1.8	59.3^{a}±1.70	59.4^{a}±2.19
OM	68.5±2.06	69.6±2.25	70.5±1.41	67.1±1.36	67.4±2.37
CP	64.5^{a}±0.76	65.9^{a}±1.06	64.3^{a}±0.89	59.7^{b}±0.87	58.2^{b}±1.11
CF	31.2±2.01	31.4±0.89	32.8±1.05	33.1±0.75	33.3±1.89
EE	76.88±0.87	77.65±0.73	76.65±0.65	77.88±0.65	78.15±0.67
NFE	69.3^{b}±0.79	73.1^{a}±1.13	72.9^{a}±0.62	74.9^{a}±1.42	74.8^{a}±1.33
TDN	64.01^{a}± 0.97	63.19^{a}±0.99	63.77^{a}±0.83	61.2^{b}±0.64	61.8^{b}±1.01

Within rows, means with different letters differ significantly (P<0.05)

Table (5): Effect of addition vitamin C to different diets energy levels on some blood rabbit's constituents (Means ± S.D.)

	Treatments				
Item	control	Group2	Group3	Group4	Group5
Cholesterol (mg/100ml)	140.58^{a}±3.78	150.0^{a}±15.0	147.0^{a}±2.87	143.47^{a}±6.7	124.4^{b}±7.66
Triglyceride (mg/100ml)	79.25^{b}±5.76	109.0^{a}±4.0	83.0^{b}±14.5	100.67^{a}±11.8	42.33^{c}±6.49
Glucose (mg/dl)	117.5^{b}±3.93	132.0^{a}±5.0	135.33^{a}±6.77	107.33^{b}±14.13	86.0^{c}±28.2
AST (U/L)	6.38±3.65	5.73±1.43	6.27±8.43	5.33±1.09	5.53±0.44
ALT (U/L)	8.78±1.97	7.3±3.7	8.33±0.88	7.3±0.94	7.97±2.5
Total protein (g/100ml)	5.63±0.26	6.05±0,05	5.2±0.35	5.1±0.34	5.37±0.23
Albumin (g/100ml)	2.3±0.11	2.5±0.25	2.6±0.09	2.3±0.13	2.4±0.12
Globulin (g/100ml)	3.3±0.27	3.5±0.3	2.7±0.27	2.8±0.15	2.97±0.12
N/L ratio	0.46^{a}±0.03	0.24^{C}±0.08	0.44^{a}±0.18	0.13^{d}±0.04	0.31^{b}±0.07

Within rows, means with different letters differ significantly (P<0.05)

Effect of different treatment on total bacteria and yeasts in caecum:

Fig. 1 shows that decreasing energy decreases the total count of bacteria and yeast in cecum. But it tends to increase in total count bacteria with rabbits fed 2633 kcal digestible energy/ kg. Yeast increase in rabbits fed 2729 kcal digestible energy/ kg with vitamin C.

Nelson *et al.*, (1963) explained that mechanisms of feed additives may include improving nutrient digestibility, controlling of pathogenic microorganisms and facilitating for a favorable intestinal microbial balance, and enhancing absorption of calorigenic nutrients.

Recovery of fungi from feed stored at different storage condition:

Because feedstuffs can be contaminated by fungi, control of additional mold growth and mycotoxin formation is dependent on storage management. Temperature and moisture content are the major factors influencing mycotoxin contamination of feed grains and foods (Coulumbe, 1993). Molds grow over a temperature range of 10-40° C and above 0.7 aw (equilibrium relative humidity expressed as a decimal instead of a percentage).

In Table (6) it's clear that diet decreasing in energy 2633 Kcal digestible energy/kg with vitamin C decrease the total fungi in different humidity and different temperature degree. It tends to decrease with 71% humidity and 30°C the fungi increase with increase storage period 30 days with relative humidity 87%.

Table shows the analysis of variance of temperature, time, temperature * relative humidity, temperature * time, relative humidity * temperature and temperature * relative humidity * time had highly significant effect on total fungi isolated from rabbits feed with two levels of energy and/or combination with ascorbic while relative humidity had non-significant effect on fungi .It was observed that, vitamin C is the compound most affected by temperature and time of storage. Increase of temperature by each 10° C caused a distinct decrease in its, also after 6 months of storage at 18.28 and 38 °C the content of vitamin C decreased by 21 %, 31 % and 81%, respectively (Klimczak *et al.*, 2007).

Micucci *et al.* (2011) as well as vitamin C was affected at low and high temperature 5 °C- 45° C, it was more affected by high temperature was observed at short time of incubation , if incubation continuous in time a loss of 100% of vitamin C was observed at the same time that a great contamination occurred.

Economic efficiency:

Data presented in Table (7) show that rabbits fed 2729 Kcal digestible energy/ Kg with vitamin C was high in total revenue, net revenue and performance index. Omer *et al.* (2012) showed that rabbits fed the 90% energy levels with the 1.5 % additive mixture (*Lupinusalbus L., Trigonella foenum graecum L.* and *Cassia senna L.*) diet recorded the highest value of relative economic efficiency (145.1%).

Fig.(1):Effect of two levels of energy and/ or combination with ascorbic acid on total count of bacteria and yeasts in caecum

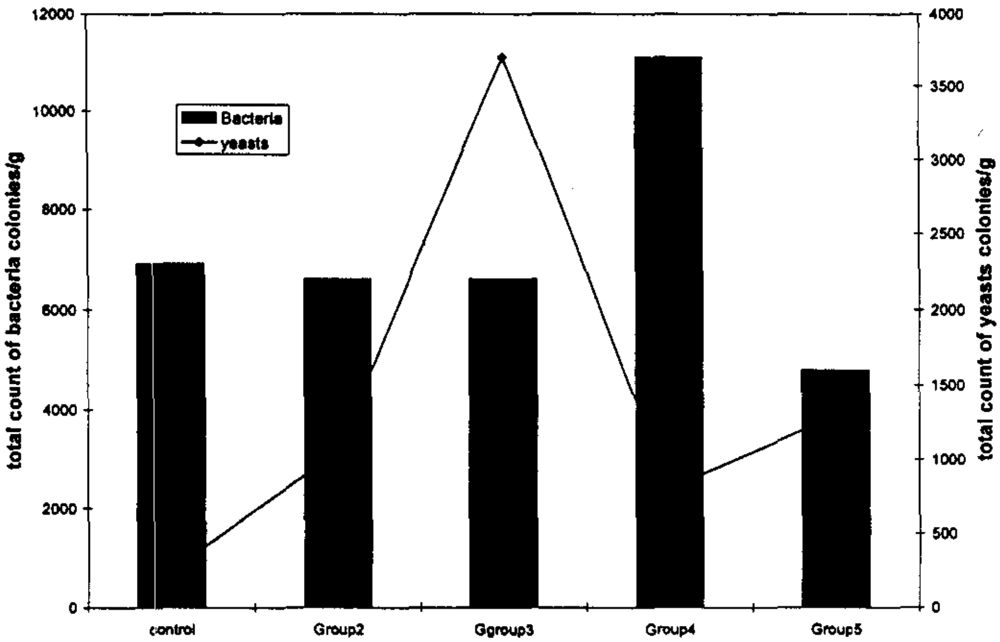

Table (7): Effects of addition vitamin C to different diets energy levels on economic efficiency.

Item	Control	Group2	Group3	Group4	Group5
Av. feed intake (kg/rabbit)a	4.96	4.78	5.05	4.26	5.47
Price/kg feed (PT)*b	200	194	213	183	202
Total feed cost (LE) a X b = c	9.92	9.27	10.75	7.79	11.1
Av. Body wt. gain (Kg/rabbit)d	1.47	1.25	1.54	1.1	1.38
Price/kg live wt. (LE)**e	22	22	22	22	22
Total revenue (LE) (d X e = f)	32.34	27.5	33.88	24.2	30.36
Net revenue (LE) (f-c=g)	22.42	18.23	23.13	16.41	19.26
Economic efficiency***(g/c)	2.26	1.97	2.15	2.11	1.7
Relative economic efficiency****	100	87.17	95.13	93.36	75.22
Performance index	67.57	53.57	72.11	48.77	55.01

**According to the price of different in ingredients available in the market at the experimental time.*

***According to the local market price at the experimental period.*

****Net revenue per unit cost.*

*****Group fed control diet (1) =100%.*

Table (6): Total fungi isolated from rabbits feed containing two levels of energy and/or combination with ascorbic acid storage at different storage condition (colonies per gram).

	Temperature degree																					
	30°C											35°C										
	Relative humidity											Relative humidity										
	71%					87%					Total	71%					87%					Total
Time (Days) / Feeds	0	10	20	30	Total	0	10	20	30	Total		0	10	20	03	Total	0	10	20	30	Total	
Control	110	105	65	143	423	110	160	60	130	460	883	110	110	445	330	995	110	90	220	150	570	1565
Group2	100	150	90	110	450	100	50	200	375	725	1175	100	300	310	220	930	100	95	110	30	335	1265
Group3	260	85	96	53	494	260	40	40	850	1190	1684	260	10	350	355	975	260	10	80	470	820	1795
Group4	75	75	83	89	322	75	126	45	409	655	731	75	65	368	285	793	75	60	185	205	525	1318
Group5	80	155	115	90	440	80	135	195	320	730	1170	80	110	180	170	540	80	60	65	80	285	825
Total	625	570	449	485	2129	625	511	540	2084	3760	5889	625	595	1653	1360	4233	625	315	660	935	2535	6768

Analysis of variance:

Sources	F value	
Temperature	1813.320	highly significant
Relative humidity	0.650	non-significant
Time	16522.440	highly significant
Temperature * relative humidity	29771.683	highly significant
Temperature * time	5967.574	highly significant
relative humidity * Temperature	8006.391	highly significant
Temperature * relative humidity * Time	8924.638	highly significant

CONCLUSION

Under the conditions of this experiment, the results indicate that, decreasing energy level from 2824 kcal digestible energy/kg requirements to 2729 kcal digestible energy/kg of requirements with 500mg vitamin C supplementation improve growth performance, some digestion coefficients of nutrients, net revenue and the performance index.

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استجابة الأرانب النامية للغذاء المحتوى على مستويات مختلفة من الطاقة وفيتامين ج.

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أجريت هذه التجربة لتقييم مدى التأثير الملطف لفيتامين ج على انخفاض الطاقة في أغذية الأرانب . تم استخدام عدد ستين أرنب ذكور واناث نيوزيلندي أبيض عمر ستة أسابيع أبيض مفطوم لدراسة تأثير مستويين مختلفين من الطاقة مع أو بدون فيتامين ج. قسمت الأرانب الى خمس معاملات وامتدت فترة التجربة الى ثماني أسابيع. المجموعة الأولى (الكنترول 2824 كيلو كالورى طاقة مهضومة / كجم) ، المجموعة الثانية والرابعة حصلت على 2729 ، 2633 كيلو كالورى طاقة مهضومة / كجم علف على التوالي بينما المجموعة الثالثة والخامسة حصلت على 2729 ، 2633 كيلو كالورى طاقة مهضومة /كجم علف مع 500 جزء في المليون فيتامين ج. تمت دراسة كفاءة النمو، هضم المواد الغذائية، ونسب الذبيحة، بعض مركبات الدم، العدد الكلى للبكتريا والخمائر في الأمعاء . وقد تم عزل الخمائر الكلية من الأعلاف المخزنة على درجات حرارة مختلفة (30 ، 35°م) ورطوبة نسبية (71 % ،87 %). أشارت الدراسة الى أن وزن الجسم والربحية في وزن الجسم في فترات مختلفة معنويا قد انخفضت مع الأرانب التي تم تغذيتها على مستوى طاقة منخفض ولكنها مالت الى التحسن مع اضافة فيتامين ج. العلف المأكول زاد معنويا مع الأرانب التي تم تغذيتها على طاقة منخفضة. أفضل معامل لتحويل العلف تم تسجيله بواسطة الأرانب التي غذيت على 2729 كيلو كالورى طاقة مهضومة/كجم. لم يكن هناك أي تأثير معنوي للمعاملات على صفات الذبيحة. الأرانب التي غذيت على طاقة منخفضة تحسن بشكل معنوي هضم المادة الجافة والكربوهيدرات ولكن انخفض معنويا معامل هضم البروتين ومجموع هضم المواد الغذائية. الأرانب التي غذيت على طاقة منخفضة 2633 كيلو كالورى طاقة مهضومة / كجم مع فيتامين ج حققت انخفاض معنوي فى نسب الكوليسترول والتراى جليسرايد والجلوكوز. لم يكن هناك أي تأثير معنوي على العدد الكلى للبكتريا والخمائر في الأمعاء. على الجانب الآخر لم يكن هناك أي تأثير معنوي على العدد الكلى للفطريات المعزولة من أعلاف أرانب والتي خزنت على درجات حرارة (30 ، 35°م) ورطوبة نسبية (71 % ،87 %) لمدة ثلاثون يوما . من هذه الدراسة يتضح أن الأرانب التي تغذت على 2729 كيلو كالورى طاقة مهضومة/كجم مع 500 جزء في المليون فيتامين ج حققت أعلى النتائج من حيث كفاءة النمو وبعض معاملات الهضم وكذلك الاستجابة المناعية وكذلك العائد الاقتصادي قد تحسن أيضا.