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EFFECT OF SOME DIFFERENT SOURCES OF VITAMIN C ON PERFORMANCE OF NEW ZEALAND GROWING RABBIT IN HOT CLIMATES.

By

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Abstract: *A total number of 72 male weaning New Zealand white rabbits were classified into 8 equal groups to study the effect of some natural of vitamin C as feed additives on growth performance and some metabolic changes. The first group was used as a control received free basal ration. The second group received vitamin C at the dose of 0.4 %. Groups from three to eight received free basal ration supplemented with rose, orange peel and sorrel at the dose of 2% without or with sodium chloride (NaCl) at level 0.35%. Final body weight was significantly increased (P<0.05) by 4.5% in vitamin C treatment compared to the control group. Also final body weight and daily gain of rabbits received basal ration supplemented with rose or sorrel without or with NaCl showed significant increment (P<0.05) by 6.0, 8.3, 8.9, 9.6% and by 11.5, 11.0, 14.1 and 17.3 %, respectively compared to the control group. Daily feed intake showed the same significant increment (P<0.05) value the in rose with NaCl and sorrel without or with NaCl treatments by 5.6% compared to the control group. Adding NaCl to rose treatment showed insignificant increment for the daily feed intake by 2.7% compared to the same treatment without NaCl.*

Total lipids were significantly (P<0.05) decreased in rabbits received rose with NaCl and sorrel without or with NaCl by 4.8, 5.2 and 6.0% respectively, compared to the control group. Total cholesterol and triglycerides levels were significantly (P<0.05) decreased in rabbit groups received vitamin C and any of the following rose, orange peel or sorrel without or with NaCl compared to the control group. The packed cell volume% (PCV) was significantly (P<0.05) increased in rabbit received vitamin C and sorrel without or with NaCl by 6.7, 11.6 and 12.4% respectively, compared to the control group.

Crude fiber digestibility showed significantly higher value in rose treatments by 12.4 and 12.8% respectively, compared to the control group. Abdominal fat weights were significantly (P<0.05) lower in dietary orange peel by 14.9 or sorrel treatments by 14.0 %, compared to the control group. The carcass dressing weight increased significantly (P<0.05) in

dietary vitamin C, rose and sorrel without or with NaCl by 5.6, 6.1, 7.1 and 6.7 %, respectively compared to the control group. The heart weights showed significant (P<0.05) increased in all treatments compared to the control group. The economic efficiency % increased markedly for sorrel with NaCl, vitamin C, sorrel, rose, orange peel with Nacl, orange peel and rose with NaCl, consecutively compared to the control group.

INTRODUCTION

Hot climate is known to have a negative effect on productive performance of rabbit production such as growth, feed intake, feed conversion, carcass traits, mortality, and lower tolerance efficiency. Increasing the ambient temperature above 30° C has a deleterious consequence on rabbit performance (Al-Shanti, 2003). Hot climate in rabbits caused a reduction of blood glucose, immune cell proliferation and immunoglobulin synthesis but increased triglycerides and urea (Amici et al., 2000). Ascorbic acid or sodium chloride are used to alleviate heat stress in broiler chicks by Hussein, (1996) and in rat by Eisenberg *et al.,* (1993) and Craig, (1999).

Ascorbic acid plays a modulating role during stress in guinea pigs (Odumosu, 1982). Also, it has a positive effect on broiler performance raised under hot climate with low mortality (Skrivanova et al., 1999 and Al-Homaidan 2000) and a synergistic antioxidant effect (Bosco et al; 2000 and Mahfouz *et al.,* 1997). Vitamin C or polyphenols increased the antioxidant enzymes in red blood cells (Dragsted et al., 2001). Therefore, it can influence the blood concentration of fibronectin which may be related either directly or indirectly to collagen metabolism (Hsu-Cheng Chin et al., 1999). Furthermore, it play a role in lowering viral antigenicity and protection as well as enhancement of the immune system of the infected rabbits (Elghaffar *et al.,* 2000).

Sodium chloride or sodium bicarbonate have an important role in alleviating heat stress by increasing water intake and thereby improving assimilation of rabbit body heat by enhancing evaporation mechanism (Abdel-Khalek, 1999 and Smith and Teeter, 1987, in broiler). Higher mineral excretion such as potassium, phosphorus, sulfur, sodium, magnesium, calcium and manganese when broilers were exposed to 35° compared to those kept at 24°C (Belay and Teeter 1996).

Rosa used is the dried fruits of *Rosa damascena. Mill*, (R.D). *Rosa damascena* in nature used as vitamin C supplements, contain polyphytochol,

hysperidin and yellow flavonoid pigment, as well as an excellent source of vitamin C (Rinzler, 1990). Linalol, citronellol and carvone are widespread natural fragrance compounds and well known genuine constituents of rose oils (Kreis and Mosandl 1992). Polyphytochol inhibited the process of lipid peroxidation (Dashinamzhilov *et al.,* 1997). Hesperidin has antihypertensive effects on normotensive rats (Galati *et al.,* 1996). *Rosa damascena* was reported to possess antiinfective, anti-inflammatory and degenerative ophthalmic disorders (Biswas et al., 2001) It exhibited moderate anti-viral activities (Mahmood *et al.,* 1996). *Rosa damascena* petals oil was evaluated for antibacterial and antimicrobial effects (Basim E and Basim H. 2003 and Aridogan *et al.,* 2002).

Orange peel contains high concentrations of phenols (Manthey, 2004). It's extract contains significant amount of beta-carotene (Ghazi, 1999), and is a good source of vitamin C (Rinzler, 1990). Citrus peel consists of significant antioxidant activity compounds that attributable to minor-occurring flavones (Manthey, 2004; and Anagnostopoulou *et al.,* 2005). Hesperidin, the most important flavanone of orange peel, has antioxidant and diuretic effects in rats (Kroyer, 1986; Galati *et al.,* 1996 and Tirkey *et al.,* 2005). Furthermore, its constituents may counteract enzymatic lipid peroxidation processest (Mtambo *et al.,* .2000).

Sorrel used is the dried wild herb of *Rumex acetosella L*. *Rumex acetosella* oil, which get their distinctive bitter flavor from a combination of sharp tasting chemicals including oxalic acid, malic acid, tartaric acid and ascorbic acid (Rinzler, 1990). Sorrel are a good source of carotenoid pigment, beta-carotene and the vitamin A precursor (Rinzler, 1990). Its leaf is a high nutritive value (Ladeji *et al* 1997), as well as an effective properties in treating cancer (Richardson *et al.,* 2000).

This study aimed to evaluate the effect of rose, orange peel and sorrel in comparative with vitamin C as well as sodium chloride as feed additives on performance of growing rabbits raised in summer conditions.

MATERIALS AND METHODS

A total number of 72 male New Zealand white rabbits with an average body weight of 778 ± 37g, were divided into eight equal groups of 9 each. The experimental period lasted for 60 days and the experimental groups were classified as follow:

Group 1 was fed the basal diet only which served as control,

Group 2 was fed the basal diet + 400mg/1kg diet vitamin C,
Group 3 was fed the basal diet + 2 % rose,
Group 4 was fed the basal diet + 2 % rose + 0.35% NaCl,
Group 5 was fed the basal diet + 2 % orange peel,
Group 6 was fed the basal diet + 2 % orange peel + 0.35% NaCl,
Group 7 was fed the basal diet + 2 % sorrel,
Group 8 was fed the basal diet + 2 % sorrel + 0.35% NaCl.

Rabbits were housed in cages provided with galvanized feeder and automatic drinkers. Rabbits of all groups were kept individually under the same managerial conditions. Live body weight was obtained and feed was offered *ad-libitum* and recorded biweekly during the experimental period lasted for 60 days. The basal experimental ration (Table 1) was formulated and pelleted to cover the requirements of rabbits according to NRC (1977).

At the end of the experiment, 3 males of each treatment group were kept in metabolic cages. Faeces were collected separately without urine. Feed and water were offered *ad-libitum*. Feed intake and excreted faeces were recorded daily for 5 days. The total excreted faeces during the 5 – day's period were pooled, well mixed, weighted and sampled for analysis. Chemical analysis of feed and dried excreta was determined according to A. O. A. C. (1980), Table (2).

Blood samples at the end of the experiment, were taken from the ear vein of three rabbits from each group for determination of plasma total protein (mg / dl), total lipids (mg / dl), cholesterol (mg / dl), triglycerides (mg / dl), packed cell volume %, hemoglobin (mg/ dl) red blood cells (RBC), and white blood cells (WBC)by using reagent commercial kits purchased from Bio- Merieux (France) following to the same steps as described by manufactures.

At the end of the experiment, 3 males of each treatment group were randomly chosen for slaughter test, carcass weights and were calculated as percentage of live body weight.

Economical efficiency % (Y) was calculated according to the following equation: Y= [(A-B)/B] x100, where A is the selling price of one kilogram live body weight obtained gain (12.0 L.E.) and B is the feeding cost of this gain (0.9 L.E.), while the cost of one kilogram of both vitamin C, rose, orange peel and sorrel were (43.0, 8.0 ,2.0 and 8.0 L.E), respectively.

Data were statistically analyzed using one-way analysis of variance and Duncan's multiple range test was used for comparison between means (SAS, 1998).

RESULTS AND DISCUSSION

Rabbits performance

Final body weight of rabbits received the basal ration supplemented with vitamin C showed significant increment ($P<0.05$) by 4.5% compared with the control group (Table 3). Final body weight and the daily gain for rabbits received the basal ration supplemented with either of rose or sorrel with or without NaCl significantly increased ($P<0.05$) by (6.0, 8.3, 8.9 and 9.6%) and by (11.5, 11.0, 14.1 and 17.3 %), respectively, compared with the control group. Also, rose with NaCl and sorrel with to or without NaCl showed the same trend ($P<0.05$) in daily feed intake by 5.6%, compared to the control group. Rose with NaCl treatment showed insignificant increment for daily feed intake by 2.7% compared to the same treatment without NaCl (Table 3).

The significant increase in final body weight for rabbits received vitamin C may be due to the effective role of vitamin C in increasing rabbit resistance during physiological stress. Similar result were obtained by Abdel-Hamid and EL-Adway (1999). Vitamin C has a positive effect on broiler performance raised under hot climate with low mortality (Skrivanova et al., 1999 and Al-Homaidan 2000). The significant increase in final body weight and body weight gain for rabbits received rose may be attributed to the promotion of mucosal protection by augmenting gastric mucin activity. Venkataranganna *et al.,* (1998) found that *Rosa damascena* has antiulcerogenic activity. Also, it may be attributed to the depressant effect of rosa oil on the central nervous system (Tisserand and Balacs, 1995). The significant increase in the final body weight and the body weight gain for rabbits received sorrel may be due to the high nutritive value of sorrel leaf. Similar result observed by (Ladeji et al 1997), who found that the fiber content in sorrel leaf did not affect the availability of dietary amino acids and minerals as shown by mostly identical serum profiles of total protein, amino acids and minerals in test and control rats. Christensen and Nielsen (2004), observed that sorrel in ostrich chicks diets increased daily feed consumption. The present study agree with that reported by Abdel-Hamid and EL-Adway (1999), who found that supplementing heat stressed-rabbit diets with either 300 or 600 mg vitamin C/Kg diet significantly improved live body weight and feed conversion. The improvement resulted in adding

NaCl to rose treatment may be due to the increment of water consumption acting as heat sink. Skrivanova and Marounek (1997) reported that growth of rabbits and feed intake were not significantly affected by NaCl.

The best economic efficiency values were recorded for sorrel with NaCl, vitamin C, sorrel, rose, orange peel with NaCl, orange peel and rose with NaCl, respectively compared to the control group (Table 3). The economic efficiency % showed markedly increase by 11.3, 10.2, 6.0, 5.3, 3.1, 1.6 and 0.6 % for sorrel with NaCl, vitamin C, sorrel, rose, orange peel with NaCl, orange peel and rose with NaCl, consecutively compared to the control group. The ameliorated of economic efficiency % were correlated with the higher of daily gain, better feed conversion, and the level as well as the price of one kilogram of feed additives regardless the mortality rate.

Blood parameters

Results in Table 4 indicated that, rosa with NaCl and sorrel without or with NaCl significantly decreased the total lipids by 4.8, 5.2 and 6.0%, to respectively, compared to the control group. Vitamin C and either rose, orange peel or sorrel without or with NaCl significantly decreased the cholesterol level by 4.7, 5.6, 6.6, 4.7, 4.6, 6.8 and 6.8% and the triglycerides level by 5.9, 5.7, 5.7, 5.9, 5.5, 7.0 and 7.1%, respectively, compared to the control group. Vitamin C and sorrel without or with NaCl significantly increased the PCV% by 6.7, 11.6 and 12.4%, respectively compared to the control group. The significant decrease in cholesterol and triglyceride in vitamin C treatment may be due to the antioxidant properties of vitamin C. Similar results were observed by Mahfouz *et al.,* (1997) who found that addition of vitamin C as antioxidant to the pure cholesterol diet reduced its severity, even when hypercholesterolaemia persisted. The reduction of cholesterol and the triglycerides in rose treatments may be due to its useful role in atherosclerosis therapy. Rose juice reduced the thickness and area of atherosclerotic plaques in the aorta and reduced serum total cholesterol (Wu-Lifu *et al.,* 1995). Also, it may be due to the effect of polyphytochol is *Rosa damascena* that inhibited the process of lipid peroxidation. The same trend in orange peel may be due to the antioxidant activity. Manthey (2004) showed that, the significant amount of the total antioxidant activity in orange peel molasses was attributable to minor-occurring flavones (Manthey 2004). Orange peel extracts constituents may counteract enzymatic lipid peroxidation processes (Malterud and Rydland 2000). Polyphytochol in citrus decreases cholestasis acting as a choleretic and bile-secreting drug, acts on the main pathogenic links in hepatitis and exerts its

marked membrane-stabilizing effect. Also, it influences favorably the processes of synthesis in the liver (Ubeeva IP *et al.,* 1990). The results suggest that the natural or vitamin C may be stimulate the conversion of cholesterol to bile acids, an important pathway of elimination.

Vitamin C and orange peel without or with NaCl significantly increased (Hb) by 23, 21,21 and 21%, respectively, compared to the control group (Table 4). Orange peel with NaCl and Sorrel without or with NaCl significantly increased the (R.B.Cs.) count, by 18, 24 and 25.5%, respectively, compared to the control group (Table 4). Vitamin C, rose with NaCl, orange peel without or with NaCl and sorrel with NaCl significantly increased the (W.B.Cs.) count by 1.66, 16.6, 18.9, 19.2 and 20.8%, respectively, compared to the control group (Table 4). The significant improvement in PCV% (Hb) gm and (W.B.C.) count in vitamin C treatment may be due to the role of vitamin C as enhancement of the immune system. Similar result were obtained by (Elghaffar et al., 2000) who reported that vitamin C had a role in lowering viral antigenicity and protection as well as enhancement of the immune system of the infected rabbits. In orange peel it may be due to the adequate amount of alpha-tocopherol in rabbits blood that simultaneously ingested the highest amounts of the vitamin C. The improvement in immune system in orange peel treatment was agreed with Ding *et al.,* (2004) who found that orange peel could greatly improve the immune function. Adding NaCl to rose, orange peel and sorrel showed insignificant effects in PCV%, (Hb) gm, (R.B.Cs.) count, and (W.B.Cs.) count or total lipids, cholesterol and triglycerides compared to the same groups without adding NaCl (Table 4).

Digestibility coefficients

Results in Table 5 did not showed significant differences in digestibility of DM, OM, CP, EE and NFE among different experimental diets. Similar results were obtained on clove and cinnamon in rabbit by Ibrahim (2000), Zeweil (1992) on artichoke canning by-products and by Ali (1998) on corn stalk. The CF digestibility showed significant increment value in rose treatments by 12.4 and 12.8%, respectively compared to the control group (Table 5). These result may be due to the antibacterial and antimicrobial effects of *Rosa damascena. Rosa damascena* petals was evaluated for its antibacterial effects against three strains of Xanthomonas axonopodis spp. Vesicatoria (Basim and Basim 2003). *Rosa damascena* contains antimicrobial activity (Aridogan *et al.,* 2002).

Carcass traits

Abdominal fat weight significantly (P<0.05) decreased in dietary orange peel or sorrel treatments by 14.9 and 14 %, respectively compared to the control group (Table 6). These result agreed with (Choi *et al.,* 2004), who found that dried orange peel compound consumption was useful for controlling body fat. These results may be due to the activities of antioxidant enzymes in orange peel. Similar results obtained by (Manthey, 2004). The carcass dressing weight was significantly (P<0.05) increased in groups fed diet contain vitamin C, rose and sorrel without or with NaCl by 5.6, 6.1, 7.1 and 6.7 %, respectively compared to the control group (Table 6). These results may be due to the influence of blood concentration with vitamin C of fibronectin that may be related either directly or indirectly to collagen metabolism. Similar result were obtained by Hsu-Cheng et al., (1999). The heart weights showed significant (P<0.05) increased in all treatments compared to the control group. These results in rose may be attributed to thickness reduction of atherosclerotic plaques in the aorta. Similar result obtained in rose juice by (Wu-Lifu *et al.,* 1995). In orange peel may be attributed to the antihypertensive and diuretic effects of hesperidin. Hesperidin, is the most important flavanone of orange peel, showed antihypertensive and diuretic effects on normotensive rats and on spontaneously hypertensive rats (Galati *et al.,*1996).

In conclusion, it appears that rose, sorrel and orange peel can be used as natural growth promoters at the level of 2% without or with NaCl for improved either of growth rabbit performance, economic efficiency and immune system as well as can be used to alleviate heat stress in growing rabbits raised in summer conditions.

Table 1. The composition of the basal ration.

Item	%
Yellow corn	20.00
Wheat bran	29.00
Clover hay	30.00
Soybean meal (44%)	16.00
Molasses	3.00
Limestone	1.15
Vit.&Min.Mix*	0.30
Bone meal	0.20
Salt	0.35
Total	100.00
Chemical composition as fed basis	
OM	93.91
CP	17.86
EE	3.64
NFE	59.13
CF	13.28
Ash	6.09
DE(kcal/kg)**	2752

* Vitamins and Minerals per one kilogram :
Vit. A. 4000000 IU, Vit. D3 50000 IU; Vit. E 16.7 g, Vit. K 0.67 g, Vit. B1 0.67 g, Vit. D_3 180000 IU, Coline chloride 400g, Pantothenic acid 6.67g, Niacin 1000 mg, Folic acid 1.67g, Biotin 0.07g, Manganese 10g, Zinc 23.3g, Iron: 25g, Calcium1.067g, Copper 600 mg, Selenium 0.033 g, Iodine 40 mg and Magnesium 133.4g.

** Calculated according to NRC (1977).

Table 2. The proximate analysis of rose, orange peel and sorrel % (on DM basis)

Item	**OM**	**CP**	**EE**	NFE	**CF**	**Ash**	**Vit.C****
Rose	75.90	14.85	3.54	38.87	18.64	24.10	537.9 mg
Orange peel	93.90	8.10	4.80	62.30	18.70	6.10	133.8 mg
Sorrel	73.20	19.70	4.25	18.05	31.20	26.80	48.1 mg

** Reported by Rinzler (1990)

Table 3. Growth performance as affected by some vitamin C supplementation to rabbit's ration, (Means ±SD).

Item	control	Vit.C	Rose		Orange peel		Sorrel	
			2%	2% + $Nacl_2$	2%	2% + $Nacl_2$	2%	2% + $Nacl_2$
Initial live body weigh (g)	772±51	803±36	758±35	798±43	763±36	786±25	781±37	761±33
Final live body weight (g)	1918±35[e]	2005±50bcd	2033±43[abc]	2077±61[ab]	1934±46[de]	2003±44[cd]	2088±30[a]	2102±36[a]
Daily body weight gain (g)	19.1±1.1[d]	19.9±1.3bcd	21.3±[illegible] 1[ab]	21.2±1.5[abc]	19.5±1.0[cd]	19.9±1.3[bcd]	21.8±1.0[a]	22.4±0.9[ab]
Daily feed intake (g)	71±1.3[bc]	69±2.2c	73±1.[illegible][bc]	75±1.7[a]	70±1.2[bc]	72±2.1[bc]	75±1.4[a]	75±1.9[a]
Feed conversion ratio	3.73±0.2	3.47±0.3	3.45±[illegible].2	3.52±0.2	3.60±0.2	3.54±0.3	3.44±0.2	3.37±0.1
Economic efficiency (%)	63.7	70.2	65.7	64.1	64.7	67.1	67.5	70.9

a.b.c.d Means in the same row bearing different letters, differ significantly (P<0.05)

Table 4. Blood parameters as affected by some vitamin C supplementation to rabbit's ration, (Means ±SD).

Item	control	Vit.C	Rose		Orange peel		Sorrel	
			2%	2% + Nacl	2%	2% + Nacl	2%	2% + Nacl
Total lipids (mg/dl)	250±5.0[a]	245±8.4[ab]	241±2.6[ab]	238±1.5[b]	244±4.5[ab]	243±2.6[ab]	237±2.6[b]	235±6.4[b]
Cholesterol (mg/dl)	85.1±1.7[a]	81.1±1.4[b]	80.31.8[b]	79.5±0.7[b]	81.1±0.6[b]	81.2±0.7[b]	79.3±1.2[b]	79.3±0.6[b]
Triglyceride (mg/dl)	84.3±0.7[a]	79.3±0.8[b]	79.5±1.1[b]	79.5±1.4[b]	79.3±0.8[b]	79.7±0.4[b]	78.4±0.8[b]	78.3±1.0[b]
Total protein (mg/dl)	7.5±1.5	7.4±0.9	7.5±0.6	7.8±0.8	7.9±0.2	7.6±0.9	8.0±1.3	7.9±0.2
PCV %	40.4±0.4[d]	43.1±0.4[bc]	41.1±0.1[d]	42.2±0.3[cd]	43.7±1.4[abc]	44.5±1.6[ab]	45.1±0.5[a]	45.4±0.8[a]
Hemo (mg/dl)	10.0±0.4[b]	11.1±0.7[ab]	11.5±0.7[ab]	11.6±0.4[ab]	12.3±0.4[a]	12.1±0.4[a]	12.1±0.9[a]	12.1±0.9[a]
RBC ($x10^6$/ml)	6.95±0.3[d]	7.09±0.2[d]	7.60±0.3[bcd]	7.51±0.4[cd]	8.07±0.3[abcd]	8.2±0.4[abc]	8.62±0.5[ab]	8.72±0.1[a]
WBC ($x10^3$/ ml)	7.35±0.2[b]	8.57±0.3[a]	8.41±0.2[ab]	8.57±0.4[a]	8.74±0.3[a]	8.76±0.4[a]	8.07±0.3[ab]	8.88±0.4[a]

a.b.c.d Means in the same row bearing different letters, differ significantly (P<0.05)

Table 5. Digestibility coefficients as affected by some vitamin C supplementation to rabbit's ration, (Means ±SD).

Item	Control	Vit..C (400mg/kg)	Rose		Orange peel		Sorrel	
			2%	2%+Nacl	2%	2%+Nacl	2%	2%+Nacl
DM	82.2±1.0	80.6±0.4	80.1±1.0	80.4±0.6	81.2±1.0	80.9±1.1	80.7±0.8	80.4±1.0
OM	80.8±1.2	80.6±1.8	78.7±2.2	79.1±0.7	79.3±1.4	78.4±0.7	77.3±1.8	77.6±1.3
CP	71.9±2.4	74.3±1.9	72.7±1.0	74.2±1.3	72.5±0.3	72.9±1.2	73.7±1.9	74.3±1.5
CF	28.2±0.9^{bc}	27.8±0.8^{c}	31.7±1.0^{a}	31.8±0.5^{a}	27.1±1.0^{c}	27.8±1.0^{c}	27.4±0.9^{c}	28.4±0.8^{bc}
EE	67.9±1.7	70.1±2.0	69.7±1.2	70.5±1.4	70.5±0.6	71.6±1.6	71.7±1.2	72.1±1.4
NFE	74.2±0.7	73.9±0.8	73.4±1.1	74.0±0.8	73.9±0.3	73.4±0.6	75.1±0.6	74.5±0.6

a.b.c Means in the same row bearing different letters differ significantly (P<0.05).

Table 6. Carcass characteristics as affected by some vitamin C supplementation to rabbit's ration, (Means ±SD).

Item	Control	Vit..C (400mg/kg)	Rose		Orange peel		Sorrel	
			2%	2%+Nacl	2%		2%	2%+Nacl
Live body weight (g)	1927±46^{c}	2075±33^{ab}	2062±25^{ab}	2105±13^{ab}	1973±45^{c}	2042±37^{b}	2118±21^{a}	2113±54^{a}
Dressing %	61.0±0.5^{b}	64.4±0.6^{a}	64.9±0.3^{a}	63.3±1.6^{ab}	63.6±1.0^{ab}	63.1±1.3^{ab}	65.5±0.7^{a}	65.1±0.7^{a}
Abdominal fat %	1.21±0.04^{a}	1.16±0.09^{a}	1.1±0.05^{a}	1.11±0.02^{a}	1.03±0.05^{b}	1.05±0.07^{a}	1.04±0.05^{b}	1.11±0.02^{a}
Liver weight %	2.97±3.0	3.31±3.3	3.63±3.6	3.48±3.5	3.42±3.4	3.59±3.6	3.03±3.0	3.16±3.2
Heart weight %	23.8±1.0^{d}	29.2±1.4^{c}	29.9±1.4^{c}	31.8±1.3^{c}	29.5±1.8^{c}	33.0±0.4^{bc}	37.9±1.5^{ab}	40.4±0.7^{a}
Kidney weight %	0.84±0.02	0.82±0.02	0.83±0.03	0.83±0.01	0.82±0.01	0.82±0.01	0.82±0.02	0.82±0.01
spleen weight %	0.23±0.04	0.27±0.02	0.26±0.02	0.27±0.02	0.23±0.02	0.26±0.01	0.28±0.01	0.29±0.01
Total giblets %	27.9±1.1^{c}	33.6±1.3^{b}	34.7±1.6^{b}	36.4±1.0^{b}	33.9±1.7^{b}	37.7±0.6^{b}	42.0±1.5^{a}	44.7±1.0^{a}

a.b.c.d Means in the same row bearing different letters differ significantly (P<0.05).

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الملخص العربي

تأثير بعض المصادر المختلفة لفيتامين ج على أداء الأرنب النيوزلندى النامى في ظروف الجو الحار

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أجريت هذه الدراسة لبيان التأثيرات الناجمة عن تغذية الأرانب النامية فى فصل الصيف على علائق مضاف إليها فيتامين ج أو بعض النباتات الطبية الغنية بفيتامين ج بدون أو بإضافة ملح الطعام بمقدار مضاعف للاحتياجات المقررة وهذه النباتات هي زر الورد (مطحون الأزهار الجافة للورد البلدي) ، مطحون قشر برتقال العصير و مطحون عشب الحميض وذلك على مظاهر النمو وبعض التغيرات التمثيلية، حيث استخدم في هذا البحث ٧٢ أرنب نمو مقسمة إلى ٨ مجموعات متساوية. تمت التغذية على عليقه متوازنة واختلفت المجموعات باختلاف الإضافات حيث غذيت المجموعة الأولى بالعليقة الأساسية واعتبرت هي المجموعة القياسية والمجموعة الثانية غذيت بإضافة فيتامين ج بمقدار ٤٠٠ملجم /١ كجم علف. أما المجموعات من الثالثة حتى الثامنة فغذيت بإضافة ٢% من أي من زر الورد وقشر برتقال العصير والحميض بدون أو بإضافة ٠,٣٥% ملح الطعام . وتم الحصول على النتائج الآتية:

١- أدت إضافة فيتامين ج أوضحت إلى زيادة معنوية في متوسط الوزن النهائي بزيادة قدرها ٤,٥% مقارنة بالمجموعة القياسية.

٢- أدت إضافة الحميض عند مستوى ٢% بدون أو بإضافة ملح الطعام إلى زيادة معنوية في كل من متوسط الوزن النهائي ومعدل الزيادة اليومية بزيادة قدرها ٦,٠ ، ٨,٣ ، ٨,٩ ، ٩,٦ % و ١١,٥ ، ١١,٠ ، ١٤,١، ١٧,٣ % على الترتيب مقارنة بالمجموعة القياسية.

٣- أدت إضافة زر الورد مع ملح الطعام وكذلك الحميض بدون أو بإضافة ملح الطعام إلى زيادة معنوية ومتساوية في كمية المأكول اليومي قدرها ٥,٦ % مقارنة بالمجموعة القياسية.

٤- أدت إضافة ملح الطعام إلى زر الورد إلى زيادة معنوية في كمية المأكول اليومي قدرها ٢,٧ % مقارنة بمجموعة زر الورد بدون ملح الطعام.

٥- أدت إضافة زر الورد أو الحميض بدون أو بإضافة ملح الطعام إلى نقص معنوي في كمية الدهون الكلية بمقدار ٤,٨، ٥,٢، ٦,٠ % على الترتيب مقارنة بالمجموعة القياسية.

٦- جميع المعاملات التي تناولت فيتامين ج أو أي من زر الورد ، قشر البرتقال، الحميض بدون أو بإضافة ملح الطعام أظهرت انخفاض معنوي في مستوى الكوليستيرول بنسبة ٤,٧ ، ٥,٦، ٦,٦، ٤,٧، ٤,٦، ٦,٨، ٦,٨% وفى مستوى الجلسريدات الثلاثية بنسبة ٥,٩ ، ٥,٧، ٥,٧ ، ٥,٩، ٥,٥ ، ٧,٠% على الترتيب مقارنة بالمجموعة القياسية.

٧- أدت إضافة فيتامين ج وكذلك الحميض بدون أو بإضافة ملح الطعام إلى زيادة في النسبة المئوية لكرات الدم الحمراء المضغوطة كأحد قياسات المناعة بنسبة ٦,٧ ، ١١,٦ ، ١٢,٤ % على الترتيب مقارنة بالمجموعة القياسية.

٨- أدت إضافة زر الورد بدون أو بإضافة ملح الطعام إلى تحسن معنوي في معامل هضم الألياف تحسن بنسبة ١٢,٤ ، ١٢,٨% على الترتيب مقارنة بالمجموعة القياسية.

٩- أدت إضافة قشر البرتقال أو الحميض إلى انخفاض معنوي لكمية دهن البطن بنسبة ١٤,٩ ، ١٤ % على الترتيب مقارنة بالمجموعة القياسية.

١٠- أدت إضافة فيتامين ج وأي من زر الورد أو الحميض بدون أو بإضافة ملح الطعام إلى زيادة معنوية في نسبة تصافى الذبيحة بمقدار ٥,٦ ، ٦,٠ ، ٦,٧ ، ٩,٠% على الترتيب مقارنة بالمجموعة القياسية.

١١- النسبة المئوية للكفاءة الاقتصادية زادت زيادة ملحوظة مقدارها ١١,٣ ، ١٠,٢ ، ٦,٠ ، ٥,٣ ، ٣,١ ، ١,٦ ، ٠,٦ وذلك للمجموعات التي تناولت الحميض + ملح الطعام ، فيتامين ج والحميض + زر الورد ، قشر البرتقال+ ملح الطعام ، قشر البرتقال ، زر الورد+ ملح الطعام على الترتيب مقارنة بالمجموعة القياسية.