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EFFECT OF ADDING ORGANIC ACIDS TO DRINKING WATER OF YOUNG RABBITS ON THEIR PRODUCTIVE PERFORMANCE UP TO MARKETING AGE.

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ABSTRACT

This study aimed to investigate effect of supplementing drinking water of growing New Zealand White (NZW) rabbits with organic acid (acetic, fumaric and ascorbic) on their productive performance, feed utilization and carcass traits. Forty - eight males of NZW rabbits at 7weeks of age were divided into 4 groups, 12 animals each. The experimental treatments were: no organic acids addition (Control), 0.5 ml acetic acid /liter drinking water (Acetic group), 0.5 ml fumaric acid /liter drinking water (Fumaric group) and 0.5 g ascorbic acid /liter drinking water (Ascorbic group). Feed and drinking water were offered *ad libitum from* 7-12 weeks of age.

The organic acids supplementation had no positive effects on live body weight at 12 weeks of age. The Acetic and Ascorbic groups showed nearly similar values of daily weight gain to the control group; however, that of Fumaric group was significantly ($p \geq 0.01$) less than the control. At 7-12 weeks, daily feed intake of Ascorbic group was comparable to that of the control group and both were significantly ($p \geq 0.01$) more than those of the Acetic and Fumaric groups. The best value of feed conversion at 7-12 weeks was recorded for the Acetic group while the poorest one was that of the Fumaric group with significant ($p \geq 0.01$) difference. The Acetic group was significantly ($p \geq 0.05$) superior in respect of protein conversion ratio at 7-12 weeks followed by Ascorbic, Control and then the Fumaric group in descending order. The Acetic group at all intervals needed less amount of digestible energy to gain one unit of live weight than the other three groups. The Fumaric acid showed significantly ($p \geq 0.01$) the poorest value performance index at all intervals among all groups. The addition of acetic acid to drinking water of rabbits resulted in better values of digestibility of all nutrients except CP than the Control group. The organic acids supplementation to drinking water of young rabbits had no obvious effects on total edible parts at 12 weeks of age.

The obtained results showed that the addition of acetic acid; to drinking water of growing rabbits had some positive effects on productive performance of young NZW rabbits, however, the fumaric acid addition almost had negative effects.

Keyword: organic acids, rabbits, live body weight, carcass, digestibility, nutritive value, drinking water.

INTRODUCTION

Organic acids are routinely included in diets for monogastric animals in Europe in order to replace antibiotics as growth promoters (Abecia et al., 2005). The main effects of dietary organic acids in weaned piglets have been extensively reviewed (Partnen et al., 1999 and Ravindram and Kornegay., 1993), consisting primarily of improved diet digestibility and growth performance.

The action mechanisms of organic acids are mainly involved in balancing the microbial population in the small intestine and/or to stimulating the activity of digestive enzymes. Similarly, acidifiers have also been assayed for intensive rabbit production diets, either as organic acids (Castrovilli 1991, El-Kerdawy 1996, Hollister et al., 1990, Scapinello et al., 2001 ,Zi lin et al., 1996), or their salts (Hullar et al., 1996), with research being focused mainly on both health and productive performances.

The objective of this experiment was to evaluate to what extent acetic, fumaric and ascorbic acids supplementation to drinking water of growing rabbits may affect their productive performance, feed utilization and carcass traits.

MATERILAS AND METHODS

This experiment was carried out at TOCTAD rabbitry (Private rabbit farm, near Manaoura city) during the period from November, 2006 to January, 2007.

Forty-eight males of growing New Zealand white (NZW) rabbits at 7 weeks of age were divided into four groups, 12 animals each. All groups were fed a complete pelleted diet. Its composition and chemical analysis were presented in (Table 1).

Table 1: Composition and chemical analysis of the experimental diet:-

Items	Values (%)
Ingredient:	
Yellow corn	20.00
Wheat bran	29.00
Clover hay	30.00
Soybean meal (44 %CP)	16.00
Molasses	3.00
Limestone	1.15
Vitamin and minerals premix*	0.30
Bone meal	0.20
Salt	0.35
Chemical analysis :	
Dry matter (DM)	89.78
Organic matter (OM)	82.33
Crude protein (CP)	17.26
Crude fiber (CF)	13.3
Ether extract (EE)	3.22
Nitrogen free extract (NFE)	48.55
Digestible energy (Kcal/kg)	2600

***Each kg of vitamin and mineral mixture contained: Vit A.2000.000 IU; E 10mg; B1 400 mg; B2 1200mg; B6 400mg; B12 10 mg; D3 180000 IU; Colin chloride 240 mg; Pantothenic acid 400 mg; Niacin 1000mg; Folic acid 1000 mg; Biotin 40 mg; Manganese 1700 mg; Zinc 1400 mg; Iron 15 mg; Copper 600 mg; Selenium 20 mg; Iodine 40 mg and Magnesium 8000 mg.**

The drinking water of the rabbits was supplemented with no organic acids (control group), 0.5 ml/liter acetic acid (Acetic group), and 0.5 ml/liter fumaric acid (Fumaric group) and
0.5 g/liter ascorbic acid (Ascorbic group) throughout the experimental period from 7 to 12 weeks of age. Drinking water was changed daily for each group. The rabbits were individually housed in galvanized wire cage, measuring 30×50×30 cm and supplied with a feeder and
a stainless steel nipple for drinking. Fresh water and pelleted diet were offered *ad libitum* throughout the whole experimental period from 7 to 12 week of age.

All rabbits were kept in a well –ventilated pen under the same managerial and hygienic conditions. Individual live body weight and feed intake were recorded weekly. Daily feed intake, daily weight gain as well as feed conversion ratio (g feed /g weight gain) were calculated weekly. Protein conversion ratio as weight gain (g) / crude protein consumed, efficiency of energy utilization as digestible energy consumed (Kcal) / weight gain (g) and performance index as live body weight (kg) × 100/ feed conversion were calculated also at the intervals 7-10,10-12 and 7-12 weeks.

At the last week of the experiment, four digestibility trials were done after the European reference methods for rabbits (Perez et al., 1995). Thereafter, 3 males from each group were randomly chosen and slaughtered after 18 hour (fasting period). Rabbits were weighed before and after slaughtering, then they were skinned and emptied. The weight of hot carcass without head, liver and giblets were recorded. The total edible parts consisted of empty carcass with kidneys, liver and head.

Digestible energy (DE) was calculated corroding to Schiemann (1972) as follows:-

DE (Kcal/kg) = 5.82(DCP g/kg) +9.5(DEE g/kg) +4.2(DCF g/kg) +4.2(DNFE g/kg).

While the total digestible nutrients (TDN) were calculated according to the classic formula of Cheek et al (1982) as follows:-

TDN% = DCP% + DCF% +DNFE% + (DEE% × 2.25) where:

DCP = Digestible crude protein, DCF = Digestible crude fiber, DNFE = Digestible nitrogen free extract and DEE = Digestible ether extract. Sample of feed and fasces were analysed for organic matter (OM), crude protein (CP), ether extract (EE), crude fiber (CF) and ash according to conventional methods of A.O.A.C (1995). Statistical analysis was carried out by the one-way analysis of variance using SAS, (2004). Significant differences between means were determined by Duncan's New Multiple range test (Duncan, 1955).

RESULTES AND DISCUSSION

Live body weight and daily weight gain:-

The organic acids supplementation had no positive effects on live body weight at 12 weeks of age. Where the control group had slightly the heaviest live weight among all groups (Table 2). The control group surpassed Acetic,

Fumaric and Ascorbic groups in live weight at 12 weeks of age by about 4.3, 9.6 and 5.1%, respectively. Daily weight gain significantly (p≥0.01) affected by organic acids supplementation where the fumaric groups had the least value at all intervals. At 7-12 weeks the fumaric group was also less than the other three groups, Control, Acetic and Ascorbic by about 22.7, 22.7 and 20.2% respectively.

The organic acids treated rabbits group showed better values of live weight and weight gain than control group as reported by (El-Kerdawy et al., 1996, Abdel -Azeem et al., 2000and Mohamed et al., 2006).

The addition of fumaric acid to rabbit deit (5-10g/kg) slightly reduced daily weight gain in comparison to the control group (Abecia et al., 2005).

Daily feed intake and feed conversion ratio:-

At 7-10 weeks, the Fumaric group significantly (p≥0.01) consumed less feed than the other groups which were nearly equals. However, the Acetic group was significantly (p≥0.01) the smallest in daily feed intake at 10-12 (Table2). At 7-12 weeks, the daily feed intake of Ascorbic group was comparable to that of the control and both were significantly (p≥0.01) higher than those of Acetic and Fumaric groups which were also nearly equals.

Table (2):- growth performance traits* as affected by organic acids supplementation to drinking water of NZW growing rabbit at various intervals.

	Organic acids in drinking water			
	control	Acetic acid	Fumaric acid	Ascorbic acid
Live body weight(g)				
Initial (7 wks)	1037.5±36.78	979.6±36.78	1029.2±36.78	1033.3±36.78
Final (12wks)	2106.4±53.47	2015.5±53.47	1903.9±59.11	2000±53.47
Daily weight gain(g)				
7-10 (wks)	30.8 ±0.86^{A}	30.7±0.86^{A}	23.8±0.95^{C}	27.8±0.86^{B}
10-12 (wks)	29.1±0.99^{A}	28.6±099^{A}	24.8±1.09^{B}	30.8±0.99^{A}
7-12 (WKS)	29.7±0.76^{A}	29.7±0.78^{A}	24.2±0.76^{B}	29.1±0.76^{A}
Daily feed intake(g)				
7-10 (WKS)	103.5±2.89^{A}	99.6±2.98^{A}	82.6±3.29^{B}	98.2±2.98^{A}
10-12 (WKS)	140.1±3.30^{A}	122.8±3.30^{B}	138±3.64^{A}	140.6±3.30^{A}
10-12 (WKS)	118.1±2.78^{A}	108.8±2.78^{CB}	105.1±3.07 ^{C}	115.2±2.78^{AB}
Feed con version ratio				
7-10 (wks)	3.45±0.12	3.33±0.12	3.34±0.13	3.60±0.12
10-12 (wks)	4.95±0.19^{B}	4.42±0.19^{B}	5.64±021^{A}	4.64±0.19^{B}
7-12 (WKS)	4.05±0.12^{AB}	3.75±0.12^{B}	4.31±0.13^{A}	4.03±0.12^{B}
protein conversion ratio				
7-10 (WKS)	1.72±0.07	1.81 ±0.07	1.68±0.08	1.66±0.08
10-12 (WKS)	1.21±0.06^{A}	1.37±0.06^{A}	1.03±0.06^{B}	1.26±0.06^{A}
7-12 (WKS)	1.44±0.06^{B}	1.62±0.06^{A}	1.33±0.06^{B}	1.47±0.06^{AB}
Efficiency of energy utilization				
7-10 (wks)	8.75±0.35	8.44±0.35	9.13±0.38	9.43±6.35
10-12 (wks)	12-69±0.43^{B}	11.29±0.49^{B}	14.68±0.54^{A}	11.99±0.49^{B}
7-12 (WKS)	10.41±0.33^{AB}	9.40±0.33^{B}	11.36±0.37^{A}	10.33±0.33^{AB}
Performance index				
7-10 (wks)	49.6±2.07	49.3±2.07	45.1±2.28	45.9±2.07
(10-12) (wks)	43.3±2.31^{A}	47.1±2-31^{A}	34.7±2.31^{B}	44.9±2.31^{A}
7-12 (WKS)	51.7±2.01^{A}	54.7±2.01^{A}	44.4±2.21^{B}	51.5±2.01^{A}

***Means within each row having similar letter(s) are not significantly different at p ≤ 0.05.**

The feed conversion ratio at 7-10 weeks didn't obviously change among groups where it ranged from 3.34 to 3.60. However at 10-12 and 7-12, weeks the Fumaric group showed less values of feed conversion ratio than the other groups where it needed significantly ($p \geq 0.01$) more feeds to gain one unit of live weight than them.

The organic acid addition to the diet of rabbits increased feed intake of rabbits and mostly improved feed conversion ratio (El-Kerdawy et al., 1996 , Abdel -Azeem et al., 2000 and Mohamed et al., 2006).

Protein conversion ratio, Efficiency of energy utilization and Performance index:-

At 7-10 protein conversion ratio weeks was nearly equal for all groups where it ranged from 1.66 to1.81. The addition of acetic acid and ascorbic acids to drinking water of rabbits at 10-12 weeks resulted in significantly ($p \geq 0.01$) better value of protein conversion ratio than those of control and fumaric acids. At 7-12 weeks the Acetic group was significantly ($p \geq 0.05$) the superior (1.62) followed by Ascorbic (1.47), control (1.44) and then Fumaric group (1.33) in a descending order.

The Acetic group at 7-10, 10-12 and 7-12 weeks needed less amount of digestible energy in order to gain one unit of live weight than the other three groups.

However, the Fumaric group showed the opposite trend at 10-12 and 7-12 weeks. Differences in efficiency of energy utilization due to organic acids supplementation to drinking water were significant ($p \geq 0.01$) at 10-12 and 7-12 weeks of age (Table2).

The Fumaric group showed significantly ($p \geq 0.01$) the poorest value of performance index at all intervals among all groups. On the other hand, Acetic group ranked the first in this concern at 10-12 and 7-12 weeks of age (Table 2).

Digestibility coefficients and nutritive value:-

The organic acids supplementation to drinking water of rabbits resulted in significant ($p \geq 0.01$) differences in digestibility coefficients of all nutrients studied (Table3).

Table (3):- **Digestibility coefficients* and nutritive value of rabbits as affected by organic acids supplementation to drinking water at different intervals of age.**

Items	Organic acids in drinking water			
	Control	Acetic Acid	Fumaric Acid	Ascorbic Acid
Digestibility coefficient :-				
OM	68.39±0.48 ^{B}	70.35±0.44 ^{A}	67.79±0.44 ^{B}	68.25±0.44 ^{B}
CP	79.95±0.46 ^{A}	78.23±0.46 ^{B}	79.86±0.46 ^{A}	81.32±0.46 ^{A}
EE	82.43±0.45 ^{B}	84.36±0.45 ^{A}	81.65±0.45 ^{B}	81.25±0.45 ^{B}
CF	56.54±0.56 ^{B}	59±0.56 ^{A}	54.41±0.56 ^{C}	55.99±0.56 ^{BC}
NFE	66.68±0.45 ^{B}	69.54±0.45 ^{A}	65.62±0.45 ^{B}	66.13±0.45 ^{B}
Nutritive value				
DCP	13.79±0.12	13.49±0.12	13.62±0.12	14.49±0.12
TDN	59.30±0.46	60.35±0.40	58.69±0.46	60.35±0.40

*Means within each row having similar letter(s) are not significantly different at $p \leq 0.05$.

The rabbits of Acetic group showed better digestibility of OM, EE, CF and NFE than those of the other groups. However, the Fumaric group showed the poorest values of digestibility coefficients of OM, CF and NFE. As regards the CP digestibility it was observed that the rabbits of Ascorbic group were the superiors (Table 3). The addition of acetic acid to drinking water of rabbits resulted in better values of digestibility of all nutrients, except, CP, than the Control group.

The organic acids supplementation showed no obvious effects on DCP (%) and TDN (%) where it ranged from 13.49 to14.49% and from 56.69 to 60.33% respectively.

(Abecia et al., 2005) showed that supplementation of the diet with Fumaric acids (5-10 g/kg) did not improve digestibility compared with control.

Carcass traits:-

Although the fasted live weight of rabbits were not significantly different at slaughter at 12 weeks of ages, the liver weight of all groups was nearly equal ranging from 56.67 to 66.67g. However, the relative weight of liver was nearly the same in Fumaric and Ascorbic groups both were significantly ($p \geq 0.01$) higher that of the Fumaric group. The Control group had intermediate value of liver weight percentage.

The hot empty carcass weight and percentage showed no great differences. The same trend was found also in total edible parts weight and percentage (Table 4).

Table (4):- Carcass traits of rabbits at 12 weeks of age as affected by organic acids supplementation to drinking water at 7-12 weeks of age.

Traits		Organic acids in drinking water			
		Control	Acetic Acid	Fumaric Acid	Ascorbic Acid
Fasted live	WT	2170±50.88	2126.67±50.88	1970±50.88	2096.67±50.88
liver	WT	63.33±2.63	56.67±2.63	63.33±2.63	66.67±2.63
	%	2.91±0.09 ^{AB}	2.65±0.09 ^{B}	3.21±0.09 ^{A}	3.18±0.09 ^{A}
Hot empty carcass	WT	1090±164.41	1061.67±164.41	973.33±164.41	1060±164.41
	%	50.22±0.36	49.87±0.36	49.4±0.36	50.55±0.36
Total edible parts	WT	1288.33±34.55	1256.67±34.55	1159.33±54.55	1248.33±34.55
	%	59.36±0.28	59.06±0.28	58.84±0.28	59.54±0.28

*Means within each row having similar letter(s) are not significantly different at $p \leq 0.05$.

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تأثير إضافة أحماض عضوية إلى ماء شرب الأرانب النامية على أدائها الإنتاجي حتى عمر التسويق .

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كان الهدف من هذه الدراسة هو بحث تأثير إضافة الأحماض العضوية (الأستيك, الفيوماريك , الأسكوربك) إلى ماء الشرب للأرانب النيوزلندي النامية و ذلك على أدائها الإنتاجي للأرانب, الاستفادة من الغذاء وصفات الذبيحة. استخدمت في هذه التجربة ٤٨ ذكر نيوزلندي أبيض عمر ٧ أسابيع, قسمت إلى ٤ مجموعات كل منها ١٢ أرنب. كانت المعاملات التجريبية كما يلي : مجموعة المقارنة (بدون إضافة أحماض عضوية) , مجموعة الأستيك (إضافة ٠,٥ مل/لتر) , مجموعة الفيوماريك (إضافة ٠,٥ مل/لتر) ومجموعة الأسكوربك (إضافة ٠,٥ جم/لتر) تم تقديم العليقة وماء الشرب حتى الشبع.

لم يكن لإضافة الأحماض العضوية تأثيرات إيجابية على وزن الجسم في عمر ١٢ أسبوع. تساوت تقريبا مجموعتي الأستيك و الأسكوربك في صفة الزيادة الوزنية اليومية مع مجموعات المقارنة في حين أن مجموعة الفيوماريك كانت أقل معنويا (عند مستوى ١%) في الفترة من ٧ إلى ١٢ أسبوع. كان استهلاك العلف اليومي في الفترة من ٧ إلى ١٢ أسبوع لمجموعتي الأستيك والفيوماريك, وقد لوحظ أن مجموعة الأستيك الأفضل في نفس الفترة بالنسبة معدل التحويل الغذائي في حين كانت مجموعة الفيوماريك هو اقلها بدرجة معنوية(عند مستوى ١%) . تفوقت مجموعة الأستيك معنويا بالنسبة لكفاءة تحويل البروتين في الفترة من ٧ إلى ١٢ أسبوع تلاها في ذلك مجموعات الأسكوربك , المقارنة والفيوماريك في ترتيب تنازلي. وقد تميزت مجموعة الأستيك في كل الفترات بحاجتها لكمية اقل من الطاقة المهضومة لتحقيق وحدة وزنية واحدة من وزن الجسم عن المجموعات الثلاثة الأخرى, أما مجموعة الفيوماريك فكانت الأقل معنوية (عند مستوى ١%) بالنسبة لدليل الأداء في كل الفترات. أدت إضافة حمض الأستيك إلى ماء الشرب إلى نتائج أفضل من المجموعة المقارنة في معاملات هضم كل العناصر عدا البروتين الخام. لم تتأثر صفات الذبيحة خصوصا الأجزاء الكلية المأكولة بإضافة الأحماض العضوية لماء الشرب.

تشير النتائج المتحصل عليها إلى أن إضافة حمض الأستيك إلى ماء شرب الأرانب كان له بعض التأثيرات الإيجابية على الأداء الإنتاجي للأرانب النيوزلندي النامية في كانت التأثيرات سلبية عند إضافة حمض الفيوماريك.