Journal of International Scientific Publications: Agriculture and Food

Volume 2, ISSN 1314-8591 (Online), Published at: http://www.scientific-publications.net

PERFORMANCE, PHYSIOLOGICAL PARAMETERS AND SLAUGHTER CHARACTERISTICS IN GROWING RABBITS AS AFFECTED BY A HERBAL FEED ADDITIVES (DIGESTAROM®)

A. M. Abd-El-Hady

Poultry Production Dept., Faculty of Agric., Alexandria University, Egypt

Abstract

The present study was conducted to a herbal feed additives (digestarom®) supplementation effects on Performance, physiological parameters and slaughter characteristics of growing rabbits. Forty-five, unsexed V-Line weaned rabbits, at 4 weeks of age with an average initial weight (530 gm) were randomly divided to three groups (15 each). First group was fed the basal diet (control) and the other groups were fed the control diet supplemented with 300 and 400 gm digestarom/ ton feed. The experimental period extended for 5 weeks. Results showed that dietary supplementation with digestarom showed the highest live body weight, body weight gain, caecal activity, carcass weight, dressing and liver percentages. Weekly feed conversion ratio was improvement with the increasing digestarom levels. The experimental additives significantly increased hemoglobin and red blood cells count.

Effect on protein metabolism revealed that digestarom treatments had not significantly increased serum total protein, albumin concentration in a level supplemented dependant manner. Digestarom treatment increased crude protein in meat composition to nearly 4.7 and 4.1% of the control rabbits content with 300 and 400 gm digestarom/ ton feed, respectively. Effect on lipid metabolism revealed a negative correlation between digestarom administration levels and body fats contents. Serum total lipid, cholesterol and triglyceride concentrations decreased. Digestarom treatments reduced abdominal fat content to nearly 38.9 and 45.1% of the control rabbits. Effect on carbohydrate metabolism elevated blood glucose, T3 concentrations had significantly increased in a level supplemented with digestarom. Effect on immunity levels revealed that digestarom treatments had decreased mortality rate to nearly 40 and 60% of the control rabbits content with 300 and 400 gm digestarom/ ton feed, respectively. A herbal feed additives (digestarom®) supplementation had significantly increased white blood cells count, globulin and IgG levels and significantly decreased a total count of harmful microorganisms (Escherichia coli and Clostridium Spp) in caecum. It can be concluded that the herbal feed additives (digestarom) administration improved productive performance, some physiological parameters and carcass characteristics of growing V-Line rabbit's line.

Key words: *herbal additives, digestarom, blood constituents, caecum microbial counts, carcass traits, growth performance, rabbit*

1. INTRODUCTION

Antibiotic feed additives have been used for more than 50 years to enhance growth performance and to prevent disease in livestock feeding environments. However, the current trend is to look for alternatives to antibiotic feed additives because of public concern about antibiotic residues in animal products and the potential evolving of antibiotic resistant bacteria. Essential oils derived from herbs have been shown to have antimicrobial effects (Dorman & Deans, 2000). Their antimicrobial mode of action consists of interactions with the cell membranes of microorganisms by changing permeability for cations such as H+ and K+ (Ultee et al., 1999). Moreover, there is evidence to suggest that herbs, spices and various plant extracts have appetizing and digestion-stimulating properties and antimicrobial effects (Gill, 1999; Langhout, 2000; Madrid et al., 2003; Alçiçek et al., 2004; Zhang et al., 2005).

As a result, new commercial additives of plant origin, considered to be natural products that consumers would accept, have been proposed to livestock producers. Herbs, spices, and various plant extracts have received increased attention as possible antibiotic growth promoter replacements.

Potential benefits of herbs and spices and plant extracts as feed additives have not yet been studied in the post-weaning period of rabbits. Herbs and spices ontain a large number of antimicrobial, spasmolytic and anti-secretory compounds, raising interest in them as feed ingredients during the weaning period. Resistance of enteropathogens such as Escherichia coli to antibiotics occurs on rabbit farms (Cerrone et al., 1999), restricting

Volume 2, ISSN 1314-8591 (Online), Published at: http://www.scientific-publications.net

the use of these drugs for prolonged periods. Therefore, feed additives with the potential to prevent digestive problems are considered as a promising alternative. In former times the health of the population was stabilized by antibacterial growth promoters. Because of new guidelines for feed additives the uses of these growth promoters have been for bitten (Jamroz et al., 2003). So herbal feed substances like digestarom® with their stabilizing influence on the intestine became a focus of public discussion.

Feed additives are products used in animal nutrition for puroses of improving the quality of feed and the quality of food animal origin or to improve the animal's performance and health.

Some of the important aspects associated with herbal additives are their ability to prevent digestive disturbances, improve feed utilization and enhance animal performance (Krieg et al., 2009). Herbal feed additives were added to the growing and fattening diets in order to improve the performance of livestock in buffalo heifers, buffalo calves and rabbits, respectively (El-Ashry et al., 1993; El-Basiony et al., 2003; Fatma et al., 2005).

Herbal extracts, probiotics and enzymes could help to improve the performance of birds (Radwan et al., 1995; Abdel-malak et al., 1995). Natural digestibility enhancers promote the inner secretion and stimulate bile and the body's enzyme production. Therefore, the digestion of the foodstuff becomes optimized and the productions of harmful metabolite substances are reduced.

During the commercial husbandry of rabbits problems always occur with infections of stomach and intestine. Diarrhoea mainly occurs within the first three weeks after weaning and the mortality rate of those rabbits range between 20 % and 50 % or more (Gidenne and Garcia, 2006). These infections mean not only an endangering of the health of the whole population but also high mortality (Lebas et al., 1998; Gidenne et al., 2005). It is also reported that by using phytogenic flavors, mortality is reduced because of optimization of the immune system (Fortun Lamothe and Boullier, 2007). Potential benefits of herbs spices and plant extracts as feed additives have not yet been studied in the post-weaning period of rabbits. Digestarom is one of the most successful alternatives to conventional growth promoters in animal nutrition. At this point, it is of special interest that digestarom can be combined with all other feed additives

Starting with specific developments in flavors of plant origin, phytogenic flavors were identified and developed to have an influence on feed conversion rate, by optimizing the utilization of the raw components in the feedstuff (Alcicek et al., 2004). The environment is also protected when using phytogenic flavors, as there is a reduction in the quantity of egested pollutants (Alçiçek et al., 2003). The aim of the experiment was investigated the effect of a herbal feed additive (digestarom) administration on productive performance, some physiological parameters and carcass characteristics of growing Alexandria line rabbits.

2. MATERIALS AND METHODS

The present study was carried out at the nucleus breeding rabbit unit of the poultry Research Center, Poultry Production Department, Faculty of Agriculture, Alexandria University.

Digestarom is a new mixture of natural finely ground herbs and spices enriched with special extracts and essential oils. According to regulation No 1831/2003 on additives for use in animal nutrition, flavors are classified as sensory additives. Therefore, digestarom is defined as a flavor for animal nutrition and is in accordance to the appropriate regulations of the European Union and the United States (all ingredients are listed by GRAS). Digestarom® 1315, MICRO-PLUS co.-Germany Konzentrate GmbH, Stadtoldendorf, which contained active components: 1-Menthol (3.00% of Peppermint), Anethol (0.45% of Anise, Fennel) and 1-Carvon (0.035% of Caraway).

2.1. Animals

Rabbits used in this study were V-Line is a synthetic maternal line originated in 1982 at the Department of Animal Science of the Universidad Politecnica de Valencia, Valencia (Spain). Litter size at weaning was considered as the criterion for selection in this line. The method that is used to evaluate the animals is a BLUP under an animal-repeatability model. A set of V-Line rabbits was imported to the Poultry Research Center, Alexandria University at the end of year 1998 (El-Raffa, 2000), multiplied for five years and after that the selection was continued under the same criterion used in Valencia.

2.2. Experimental design

A total number of 45 unsexed weaned V-Line rabbits, aged 4 weeks and averaged 530 ± 20 gm body weight were randomly divided into three experimental groups (15 rabbits in each). Each treatment was divided into

three equal replicates, each of 5 rabbits. The 1st group fed a complete pelleted diet and served as control. The 2nd group was fed with 300 gm digestarom/ ton feed and the 3rd group was fed with 400 gm digestarom/ ton feed.

2.3. Flock management

The rabbits were housed in galvanized wire (40 × 50 × 35 cm) cages provided with feeders and automatic watery system, in a well ventilated building and were kept under the same managerial, hygienic and environmental conditions (El-Raffa, 2000; El-Raffa, 2005). A period of 14-16 hours of day light was provided. Feed and water were available all time ad libitum during the experimental period. The commercial basal pellet diet was formulated to cover the nutrient requirements contained 17.53% crude protein, 12.61% crude fiber, 3.59% fat and 2457 kcal /kg diet were provided with all required vitamins and minerals as recommended by (N.R.C, 1994). Clean fresh water was available for rabbits all the time. Manure was dropped from the cages on the floor and were collected and removed daily. Offspring were weaned at the 28th day of age and were weighted and identified.

2.4. Data collected for rabbit's performance

Individual live body weight, body weight gain, feed consumption; feed conversion ratio (FCR) and mortality rate were recorded weekly during the experimental period, from 4 to 9 weeks of age.

2.4.1. Blood analysis

At the end of the experiment (at 9 week of age), about 3 ml blood, were taken at 08:00 – 09:00 h am from the marginal ear vein under vacuum in clean tubes with or without heparin before slaughtering time, coagulated blood samples were centrifuged for 15 minutes on 4000 rpm and the clear serum was separated and stored in a deep freezer at -20 oC until biochemical analysis. Non-coagulated blood was tested shortly after collection for estimating blood picture. Red blood cells (RBCs) and white blood cells (WBCs) were counted according to Feldman et al., (2000). Hemoglobin concentration and packed cells volume percentages were measured according to (Drew et al. 2004).

Blood constituents including serum total proteins, albumin, were measured using suitable commercial kits according to guidelines and recommendation of Bogin and Keller, (1987). Globulin level values were obtained by subtracting albumin values from the corresponding values of total protein. Serum total lipids and serum triglyceride concentration were determined by using special kits delivered from CAL-TECH Diagnostics, INC, (CAL) Chino, California, U.S.A. according to recommendation of Fringes et al., (1972).

Serum total cholesterol was determined on individual bases using the specific kits according to recommendation of Bogin & Keller, (1987).

Plasma glucose concentration was measured by the (Trinder, 1969) method using commercial kits.

Plasma Triiodothyroxin (T3) and thyroxin (T4) concentrations were determined with enzyme immunoassay using commercial kits obtained from immunotech crop, Boston, MA 02134 as described by (Darras et al., 1992).

The concentration of immunoglobulins (IgG) in the blood serum was measured using the automatic biochemistry analyzer (HITACHI 747, Japan) according to Micini et al., (1965).

2.4.2. Slaughter procedure

At the end of the experimental period at (9 weeks of age), five rabbits from each group were randomly taken, fasted for 12 hours, weighted individually and slaughtered to complete bleeding (Cheeke et al., 1987). After bleeding, rabbits were weighted and skinned. Then, they were weighted after skinning to calculate the pelt weight by the differences between weights of carcass before and after skinning. After slaughtering and skinning the carcasses were eviscerated.

Dressing percentage included relative weights of carcass, giblets and head. While, non-carcass fat included relative weights of carcass, giblets of liver, kidney, heart, pancreas, caecum, full stomach, full intestine, abdominal fat, thyroid and adrenal. Intestine and caecum lengths were also measured.

2.4.3. Caecal activity

After slaughtering, individual measurements on length, circumference and full weight of the caecum were taken for all slaughtered rabbits. Also, samples from caecal contents were taken for the determination of dry matter (DM) (A.O.A.C., 1984); concentrations of ammonia nitrogen (NH3-N) and volatile fatty acids (VFAs) of

caecum content were determined by applying Conway (1958) and Eadie et al. (1967) methods. Values of pH for caecum contents were recorded immediately by using EIL pH meter.

2.4.4. Caecum microbial count

Total number of caecum bacteria was counted according to American Public Health Association, ***APHA (1960)*** and ***Difco, (1989)***. Also, E.coli, Clostridium Spp. and salmonella was examined according to ***Mackie*** and ***Me-Carteny (1953)***. Technique of colony forming unit (CFU) was adopted and incubation took place at 30 ^{o}C for 2-7 days.

2.4.5. Chemical meat composition

Meat samples (about 20g) were taken from fur part which was separated from bone then weighted and kept for chemical analysis of moisture, crude protein, ether extract and a according to the official methods of (A.O.A.C., 1990).

2.4.6. Statistical analysis

The experiment was set in a completely randomized design. Data were analyzed by analysis of variance using the general liner model procedure (Proc GLM; SAS Institute, 1999). Differences among means were determined using Duncan's test (Duncan, 1955).

3. RESULTS AND DISCUSSION

3.1. Growth performance

3.1.1. Body weight and body weight gain

Digestarom administration to 4 weeks old rabbits significantly ($P \leq 0.05$) increased average body weight during the last experimental week (9 weeks) compared with the control (Table 1). Rabbits fed 300 and 400 gm digestarom/ ton feed recorded higher ($P \leq 0.05$) final body weight at 9 weeks of age, than control group by 5.9 and 6.4% respectively.

Averages of body weight gain of rabbits fed 300 and 400 gm digestarom/ ton feed was increased by about 4.7 and 7.9 % compared with control group during the whole experimental period, from 4 to 9 weeks of age, respectively.

Similar results were reported by many investigators, Jamroz and Kamel (2002) observed improvement of 8.1% in daily gain in 17 day old poults fed a diet supplemented with a plant extract at 300 ppm. In this respect, El-Shenawi, (1992) noticed that thyme and fennel promote the absorption of fat which lead to more gain when compared with control group. Moreover, Teodorovic et al., (1990) showed higher daily weight gain when thyme and fennel were added to pig's diets 1-2 kg/ ton diets than control. Positive effects of dietary essential oils on body weight were observed by Alçiçek et al. (2003) and Denli et al. (2004). Hernandez et al. (2004) also found that the addition of two plant extracts to a broiler diet significantly improved broiler body weight at 35 days of age. Moreover, Jamroz et al. (2003) found that the inclusion of 150 or 300 mg/kg of a plant extract containing capsaicin, carvacrol and cinnamicaldehyde in a diet improved body weight by 5.4 and 8.1%, respectively.

In same results, positive effects of dietary essential oils on body weight were observed by ***Alçiçek et al. (2003)*** and ***Denli et al. (2004)***. ***Hernandez et al. (2004)*** also found that the addition of two plant extracts to a broiler diet significantly improved broiler body weight at 35 days of age. Moreover, ***Jamroz et al. (2003)*** found that the inclusion of 150 or 300 mg/kg of a plant extract in a diet improved body weight by 5.4 and 8.1%, respectively.

3.1.2. Feed consumption and feed conversion ratio

Digestarom addition to rabbit diets at level of 300 and 400 gm/ ton had no significant effect on feed consumption, except feed consumption of rabbits fed 300 gm digestarom/ ton feed at weeks 5-6 was decreased by about 19.3% compared with control group. Whereas, rabbits weekly feed conversion ratio (FCR) were improved with the increasing in digestarom levels. Results on table 1 shows that average values of FCR of growing V-Line rabbits fed different digestarom levels of 300 and 400 gm were significantly improved by (9.4 and 11.0) and (11.8 and 11.8)% comparing with control group during the last week and the total experimental period, respectively. Improvement of FCR as a result of addition of digestarom to the diets could be attributed to the reduction in feed consumption accompanied with a significant ($P \leq 0.05$) increase in live body weight. Our findings on feed intake and feed conversion are also in agreement with those of Lee et al., (2003) who studied

Volume 2, ISSN 1314-8591 (Online), Published at: http://www.scientific-publications.net

carvacrol from oregano; Madrid et al., (2003) who studied the effect of plant extract and those of Alcicek et al., (2004) who used 48 mg/kg of an essential oil mixture in the diet of broiler. In this respect, Denli et al., (2004) reported that the addition of fennel essential oil to a quail diet improved feed conversion ratio. Also, Halle et al., (2004) noted that the addition of oregano and its essential oil reduced daily feed intake of broilers and significantly improved FCR. Furthermore, Ibahim et al., (2000) who showed a significant increase (P<0.05) in feed conversion when male weaned NZW rabbits fed on diets with supplemented of Peppermint leaves at 0.5 %. The improvement in feed efficiency achieved with essential oil mixtures could be attributed to their positive effects on nutrient digestibility, as reported by (Langhout 2000; Madrid et al., 2003 and Hernandez et al., 2004).

Table 1: Growth performance as affected by dietary supplementation of digestarom togrowing rabbits.
a, b, c Different letters within a column denote significant differences between treatments.

Traits	Control	300 mg	400 mg	P value
Body weight (gm)				
Week 4	543.00 ± 22.27	539.67 ±16.22	533.00 ± 28.26	0.96
Week 5	758.00 ± 21.33	787.00 ± 26.74	758.00 ± 35.44	0.75
Week 6	954.33 ± 24.58	981.67 ± 23.80	1013.67 ± 38.71	0.40
Week 7	1234.58 ± 40.06	1291.54 ± 21.81	1302.14 ± 36.89	0.51
Week 8	1505.00 ± 24.91	1573.85 ± 24.80	1594.62 ± 37.55	0.42
Week 9	1738.50 ± 29.94^{b}	1840.42 ± 19.82^{a}	1850.38 ± 31.39^{a}	0.04
Body weight gain (gm)				
Week 4-5	215.00 ± 12.19	247.33 ± 22.29	247.33 ± 16.12	0.21
Week 5-6	196.32 ± 18.02	194.66 ± 29.53	233.34 ± 15.24	0.50
Week 6-7	287.33 ± 12.84	266.67 ± 18.75	258.50 ± 19.78	0.51
Week 7-8	263.33 ± 13.74	275.83 ± 20.70	292.37 ± 41.68	0.81
Week 8-9	233.50 ± 4.44	266.67 ± 18.75	258.50 ± 19.78	0.65
Week 4-9	1195.50 ± 18.11^{b}	1251.17 ± 25.09^{ab}	1290.00 ± 67.54^{a}	0.03
Feed consumption (gm)				
Week 4-5	597.66 ± 33.97	584.00 ± 15.28	590.00 ± 14.90	0.92
Week 5-6	654.33 ± 46.17^{a}	528.00 ± 15.87^{b}	687.83 ± 26.18^{a}	0.03
Week 6-7	1009.50 ± 41.74	891.00 ± 62.36	845.17 ± 53.08	0.16
Week 7-8	913.50 ± 28.75	843.33 ± 32.40	876.67 ± 47.53	0.40
Week 8-9	887.83 ± 19.21	900.50 ± 19.21	877.01 ± 11.81	0.25
Week 4-9	4062.83 ± 75.89	3746.83 ± 80.72	3872.83 ± 107.40	0.13
Feed conversion				
Week 4-5	2.78 ± 0.08	2.46 ± 0.27	2.43 ± 0.16	0.29
Week 5-6	3.37 ± 0.16	3.16 ± 0.36	3.02 ± 0.28	0.75
Week 6-7	3.52 ± 0.06	3.38 ± 0.26	3.34 ± 0.28	0.83
Week 7-8	3.49 ± 0.12	3.15 ± 0.33	3.22 ± 0.45	0.80
Week 8-9	3.81 ± 0.10^{b}	3.45 ± 0.26^{a}	3.39 ± 0.26^{a}	0.04
Week 4-9	3.40 ± 0.03^{b}	3.00 ± 0.08^{a}	3.00 ± 0.19^{a}	0.03
Mortality (No.)	5	3	2	

3.2. Hematological profile

Results presented in Table 2 shows that, values of each of blood components including hemoglobin concentration and red blood cells count were significantly (**P**≤0.05) higher in V-Line growing rabbits dietary

supplemented with 300 and 400 gm digestarom/ ton feed than control group, by percentage of (12.11 and 13.12%) and (5.82 and 3.61%), respectively. But packed cells volume (PCV) percentage was indicated no significant differences (P<0.05) between treatments when V-Line rabbits fed diets supplemented with digestarom. The improvements in the blood components as a result of treatment with digestarom may be due to increasing of metabolic cycles. Ibrahim et al., (2000) found significant increase values in RBCs count, Hb and PCV% in males of New Zealand rabbits aged eight weeks supplemented with 0.5% of peppermint.

In contrast, Galib, (2010) found that hematological parameter results indicated no significant differences (P<0.05) between treatments when (Hubbard) broilers fed diets supplemented with dry peppermint for six weeks, the values are in correspondence with that of the normal range for healthy birds stated by (Mitruka and Rawnley 1977).

3.3. Carbohydrate metabolis:

3.3.1. Blood glucose, T3 and growth hormones

Digestarom supplementation significantly ($P\leq$0.05) increased rabbits blood glucose concentration (Table 2) compared to the untreated animals, the digestarom addition to rabbit diets at level of 300 and 400 gm/ ton changed blood glucose concentrations by 27.8 and 23.8%, respectively. This may be due to the significant ($P\leq$0.05) increase in the body weight gain (Table 1), hematological parameters (Hb and RBC) in (Table 2). Also, serum T3 and growth hormones concentration increased significantly with diet contained 300 and 400 gm digestarom/ ton feed by (11.4 and 13.7%) and (18.0 and 19.0%), respectively compared with the control group. However, blood components are intimately related to metabolism of carbohydrate. In this respect, **Ibrahim *et al.* (2000)** reported that the metabolic changes of blood glucose and T3 showed highly significant improvement in male New Zealand rabbits aged eight weeks supplemented with 0.5% of peppermint and thyme.

Table 2: Some blood constituents as affected by dietary supplementation of digestarom to growing rabbits.

[a, b, c] Different letters within a column denote significant differences between treatments.

RBC (10^6/ mm^3)	4.98 ± 0.13^b	5.27 ± 0.18^a	5.16 ± 0.19^a	0.02
WBC (10^3/ mm^3)	6.28 ± 0.54^b	7.33 ± 0.14^a	7.35 ± 0.19^a	0.04
Lymphocyte (%)	55.92 ± 2.71^b	65.68 ± 3.27^a	63.18 ± 2.58^a	0.03
PCV (%)	32.28 ± 1.05	35.18 ± 1.27	32.13 ± 1.45	0.15
Total protein (gm/ dl)	5.99 ± 0.10	6.52 ± 0.70	6.57 ± 0.59	0.67
Albumin (gm/ dl)	3.91 ± 0.33	3.62 ± 0.35	3.68 ± 0.13	0.67
Globulin (gm/ dl)	2.08 ± 0.40^b	2.91 ± 0.69^a	2.88 ± 0.60^a	0.05
Total lipid (mg/dl)	242.18 ± 5.99^a	203.74 ± 10.39^b	188.81 ± 2.68^b	0.01
Cholesterol (mg/dl)	98.95 ± 9.69^a	93.87 ± 3.33^b	88.49 ± 5.43^{ab}	0.53
Triglyceride (mg/dl)	126.38 ± 5.72^a	105.41 ± 1.82^b	107.08 ± 4.86^b	0.01
Glucose (mg/dl)	101.38 ±7.06^b	129.55 ± 7.28^a	125.51 ± 1.84^a	0.04
T3 (ng/ml)	6.94 ± 0.53^b	7.73 ± 0.45^a	7.89 ± 0.58^a	0.04
Growth hormone (ng/ml)	26.25 ± 0.86^b	30.97 ± 1.25^a	31.23 ± 0.79^a	0.01
IgG (mg/dl)	52.36 ± 1.28^b	62.16 ± 1.53^a	60.95 ± 1.60^a	0.01

3.4. Lipids metabolism

3.4.1. Serum total lipids, cholesterol and triglycerides

Volume 2, ISSN 1314-8591 (Online), Published at: http://www.scientific-publications.net

Presented in Table (2) reveals that digestarom treatment had significantly ($P \leq 0.05$) reduced serum total lipids of growing rabbits by 15.8 and 22.0%under rabbits fed diets contained 300 and 400 gm digestarom/ ton feed, respectively compared to the he significant reduction in both serum cholesterol and triglycerides which was associated with the digestarom supplementations. Where serum cholesterol reduction reached 5.1 and 11.8% of control with the tow experimental levels respectively, with regard to triglycerides, these values were 16.6 and 15.3%, respectively. This result agrees with ***Sharma (1984)*** who found that fenugreek decreased total lipid and cholesterol values in rats. Also, Zeid (1998) reported that total lipid of goats fed diets containing medicinal plants was decreased.

3.4.2. Abdominal fat

Results in Table 4 illustrates that digestarom treatments had significantly decreased abdominal fat percentage to nearly 38.9 and 45.1% of the control rabbits. Our findings are in agreement with the results of the supplementation of the diet with thyme essential oil significantly decreased ($P \leq 0.05$) abdominal fat weight and abdominal fat percentage in quails fed with thyme essential oil **(*Denli et al., 2004*)**. On the other hand Bozkurt et al., (2009) who used oregano essential oil and hop extract supplementation on the slaughter characteristics of male broilers, they found decrease in abdominal fat percentage but not significant. These results may be interpreted that essential oils and organic acid or probiotic supplementation to a diet may have different effects on the intestinal system of chickens. This decrease may be attributed to the presence of unsaturated fatty acids in digestarom that increase fat utilization. The same conclusion observed by Abou-Zeid et al., (2007) showed that the abdominal fat decreased significantly in rabbits fed Nigella Sativa and sunflower protein meal diets compared to the rabbits fed basal diet by 6.3 and 22.5%, respectively.

3.5. Protein metabolism

3.5.1. Serum total protein and albumin

Data concerning serum total protein and albumin presented in (Table 2) indicate that digestarom treatments were not significantly affected on protein metabolism in all groups.

3.5.2. Chemical meat composition

Data in (Table 3) shows that, crude protein content and ether extract percentage increased significantly with diet contained 300 and 400 gm digestarom/ ton feed by (4.7 and 4.1)% and (8.9 and 8.3)%, respectively compared with the control group. On the other hand, carcass moisture content and ash of rabbits fed diets contained 300 and 400 gm digestarom/ ton feed not significantly affected compared with the control group. These results were agreement with those obtained by ***El-Manylawi** et al., (2005)* who showed that carcass protein of rabbits fed diets contained 6 or 9% of Geranium by-product increased significantly compared with the control group.

3.6, Immunity levels

3.6.1. Blood white blood cells count, globulin and IgG

Results presented in Table 2 shows that, values of white blood cells count and lymphocyte percentage were significantly ($\mathbf{P} \leq 0.05$) higher in V-Line growing rabbits dietary supplemented with 300 and 400 gm digestarom/ ton feed than control group, by percentage of (16.7 and 17.0%) and (17.4 and 13.0%), respectively. The lymphocyte is considered the main type of white blood corpuscles and a good indicator of the increase in immune efficiency (Wieslaw et al., 2006).

Digestarom supplementation significantly ($P \leq 0.05$) increased rabbits serum globulin concentration (Table 2) compared to the untreated animals, the digestarom addition to rabbit diets at level of 300 and 400 gm/ ton changed blood globulin concentrations by 4.0 and 3.9%, respectively. This result agrees with Galib (2010) who found that peppermint increased serum globulin concentration in broilers fed diets supplemented with dry peppermint (Mentha piperita L.),which are among the alternative growth promoters.

Serum IgG concentration was significantly ($P<0.05$) higher in V-Line growing rabbits in (Table 2) dietary supplemented with 300 and 400 gm digestarom/ ton feed than control group, by percentage of (18.7 and 16.4%), respectively compared with the control group. The results of the present study are in agreement with the observations made by Wang et al. (1998) reported that eugenol improved immune ability by increasing synthesis of IgG in body and synthesis of IgA in saliva. Essential oils improved immune response by increasing phagocytosis.

Volume 2, ISSN 1314-8591 (Online), Published at: http://www.scientific-publications.net

Table 3: Averages of digestibility coefficient, caecal characteristics, caecal activity, meat composition and caecum microbial counts as affected by dietary supplementation of digestarom to growing rabbits.

[a, b, c] Different letters within a column denote significant differences between treatments.

Traits	Control	300 mg	400 mg	P value
Caecal characteristics				
Length (cm)	43.00 ± 2.08[b]	51.63 ± 1.81[a]	51.70 ± 1.65[a]	0.02
Circumference (cm)	8.06 ± 0.62	8.27 ± 0.26	8.27 ± 0.44	0.90
Full weight (gm)	95.00 ± 3.61	88.67 ± 2.03	87.67 ±3.38	0.12
Empty weight (gm)	26.33 ± 1.45	27.00 ± 2.65	29.33 ± 1.86	0.56
Caecal activity				
DM ca. content (%)	24.00 ± 0.26	24.07 ± 0.34	23.9012 ± 0.20	0.90
VFAs (mEq/ 100gm)	5.17 ± 0.22[b]	7.20 ± 0.36[a]	7.27 ± 0.18[a]	0.02
NH_3N (mg/ 100gm)	17.00 ± 0.21[b]	19.10 ± 0.38[a]	18.53 ± 0.32[a]	0.02
PH of Caecal	6.13 ± 0.05	6.18 ± 0.03	6.21 ± 0.04	0.39
Caecum microbial counts (log^{-1}cfu/ml)				
Total bacteria counts	6.70 ± 0.08[a]	4.72 ± 0.26[b]	5.02 ± 0.13[b]	0.002
Escherichia coli	7.13 ± 0.33[a]	5.76 ± 0.32[b]	5.39 ± 0.25[b]	0.003
Salmonella	5.27 ± 0.27	4.53 ± 0.15	4.38 ± 0.20	0.122
Clostridium Spp.	2.40 ± 0.15[a]	1.90 ± 0.10[b]	1.86 ± 0.05[b]	0.047
Meat composition				
Moisture (%)	75.13 ± 0.20	74.13 ± 0.29	74.17 ± 0.15	0.08
Crude protein (%)	19.07 ± 0.12[b]	19.97 ± 0.23[a]	19.86 ± 0.17[a]	0.05
Ether extract (%)	3.03 ± 0.04[b]	3.30 ± 0.05[a]	3.28 ± 0.06[a]	0.03
Ash (%)	1.77 ± 0.13	1.61 ± 0.01	1.70 ± 0.16	0.66

3.6.2. Caecum microbial counts

Data in Table 3 shows that rabbits fed the experimental diets 300 and 400 gm digestarom had significantly lower counts of total bacteria, Escherichia coli, Salmonella and Clostridium sp. Compared to control diet. As a result of addition of digestarom to the diets could be attributed to the reduction of harmful caecum microbial counts and influence the intestinal micro biota by changing the intestinal environment to less appropriate conditions for pathogenic bacteria. In this respect, ***Cross et al. (2007)*** found that the caecal coli-form populations in birds fed some of herbal count than those fed the control diet and indicated that these dietary herbs may select more against gram-positive rather than gram-negative bacteria and may be the conditions become suitable for the presence of Campylobacter sp.

Improvement of the microflora balance and the decrease of E.coil and Clostiridium population and stimulating of the Lactobacillus spp .Proliferation, were also involved in the advantage of these oils. Intestinal villi layer production, antibacterial, antiviral and anti diarrhea activity and stimulation of the immune system were also enhanced (Horbowicz, 2000; Jamroz et al., 2004).

Volume 2, ISSN 1314-8591 (Online), Published at: http://www.scientific-publications.net

*3.6.3. Mortality rat***e**

As shown in Table 1 the numbers of rabbits died were 5, 3 and 2 for groups with 0, 300 and 400 gm digestarom/ ton feed, respectively. The mortality rate (33.3%) due to diarrhea was recorded for rabbits fed control diet, but percentage of mortality were 20.0 and 13.3% at level of 300 and 400 gm digestarom, respectively. All such animals died during the first growing period (28-49 days of age). These results may indicate that, digestarom stimulates the immune system by the phytogenic components resulting in reduction of morbidity and mortality (www.info@micro-plus.com). Our findings on mortality rate are also in agreement with those of (Teodorovic et al. 1990). They noticed lower mortality rate when thyme was added to pig's diets at 1-2 kg/ton diets than control. Galib, (2010) studied the effect of dry peppermint (0.00%, 0.25%, 0.50%, 1.00% and 1.50%) on mortality rate of Hubbard broiler chicks throughout 6 weeks of age. He shows that the improvement in the mortality may be due to the role of herbal plant (peppermint) in the immune stimulating factor. Also, Ocak et al., (2008) showed that mortality was lower in one-week-old broilers (Ross-308) fed the peppermint diets than in birds fed control diets for the entire growing periods (0.00 vs. 2.88%, respectively).

3.7. Caecal characteristics and activity

Length and full weight of the caecum and concentrations of VFAs and NH_3N in caecal contents were significantly affected by dietary treatments, being higher for the diets containing 300 and 400 gm digestarom than the control group. Meanwhile, caecal circumference, full and empty weight of the caecum and DM percent and PH of the caecal contents were not significantly affected by digestarom. However, VFA concentration in the caecum was not different among experimental groups when **Krieg *et al* (2009)** added 300 mg digestarom/kg diet to growing rabbit's diets. The same results were in agreement with El-Manylawi et al., (2005) who noticed that, no differences in TVFA concentration when growing rabbits fed diets contained with Geranium or Spearmint compared with the control group.

3.8. Slaughter procedure

Data of carcass traits presented in Table 4 shows that rabbits fed the experimental diets 300 and 400 gm digestarom had significantly higher weight of Pre-slaughter, hot carcass and dressing percentages than control group by (5.2 and 6.3%), (5.1 and 5.9%) and (4.4 and 5.5%), respectively. Also, relative weights of liver was significantly increased by increasing the dietary digestarom levels by (8.2 and 15.3%), respectively compared with the control group. But, skin, kidney, heart, pancreas, caecum, full stomach, full intestine, thyroid and adrenal glands weight percentages and intestine length were not significantly different among experimental groups. This improvement in relative weights of hot carcass, dressing and liver as a result to the reduction in the alimentary tract percentage may be due to that addition of digestarom resulted in increase in digestibility coefficient of nutrients and maintaining the acidic condition in the hindgut which is optimal for better feed utilization.

Table 4: The effects of dietary supplementation of digestarom on carcass characteristic to growing rabbits.

Traits		Control	300 mg	400 mg	P value
Pre-slaughter	gm	± 22.05[b] 1821.67	± 17.40[a] 1916.67	± 6.67[a] 1936.67	0.03
Carcass	%	56.00± 0.11[b]	± 0.94[a] 58.87	± 0.56[a] 59.30	0.04
Dressing	%	62.08± 0.47[b]	± 0.94[ab] 64.84	± 0.51[a] 65.49	0.05
Skin	%	± 0.24 13.75	± 0.83 14.19	± 0.67 13.51	0.90
Liver	%	± 0.12[b] 3.80	± 0.07[a] 4.11	± 0.07[a] 4.38	0.01
Kidney	%	± 0.05 0.77	± 0.04 0.76	± 0.06 0.79	0.93
Heart	%	± 0.01 0.38	± 0.02 0.42	± 0.02 0.41	0.48
Pancreas	%	± 0.03 0.30	± 0.05 0.31	± 0.04 0.30	0.91
Caecum	%	5.22 ± 0.21	± 0.01 4.92	± 0.08 4.94	0.81
Full Stomach	%	± 0.20 3.75	± 0.09 3.57	± 0.05 3.49	0.42
Full Intestine	%	9.78± 0.40	± 0.18 9.83	± 0.12 9.35	0.42
Abdominal fat	%	1.13± 0.20[a]	± 0.06[b] 0.69	± 0.05[b] 0.62	0.05
Thyroid	%	± 0.0006 0.0152	± 0.0007 0.0164	± 0.0005 0.0176	0.15
Adrenal	%	± 0.001 0.0068	± 0.0013 0.0086	± 0.0011 0.0095	0.29
Intestine length	cm	± 4.16 327.00	± 7.97 345.33	± 6.44 348.33	0.15

[a, b, c] Different letters within a column denote significant differences between treatments.

Our findings are in agreement with the results of ***Abd El-Latif et al. (2002)*** stated that, the highest values of dressing and edible giblets were noticed when Japanese quail fed either dietary Thyme or Fennel compared with control group. Those results were in accordance with those found by ***El-Manylawi et al. (2003)*** when added Cumin fruits and thyme leaves to growing rabbit's diets. On the other hand, ***Hernandez et al (2004)*** who found no differences in gizzard, liver and pancreas weights of broiler chickens fed diet containing an essential oil extract from oregano, cinnamon and pepper and a labiatae extract from sage, thyme and rosemary. Similar results were observed by ***Jamroz et al. (2005)*** who used essential oils in broiler diets based on maize and locally grown cereals. In contrast, **Denli *et al*. (2004)** indicated that inclusion of thyme and black seed essential oil increased intestinal weight and intestinal length in quail.

4. CONCLUSION

It could be concluded that a herbal feed additive (digestarom®) is a good unconventional feedstuff for V-Line growing rabbits and can be included in their diets up to 300 gm digestarom per ton feed without adverse effects on productive performance, blood constituents and immunity levels of growing rabbits.

REFERENCES

Abd El-Latif, S. A., Faten A. Ahmed and A.M. El-Kaiaty, 2002. Effect of feeding dietary Thyme, Black Cumin, Dianthus and Fennel on productive and some metabolic responses of growing Japanese quail. Egyptian Poultry Science, no. 1, pp. 109.

Abdel-malak, N.Y., M.S. Abdel-malak, G. M. El-Oendi and E. F. Naguib, 1995. Effect of feeding different levels of herbal feed addititive on broiler performance in relation to some metabolic functions. Egyptian Poultry Science, vol. 15 pp. 111-139.

Abou-Zeid A. E., K. Amber and M.M. El-Adawy 2007. Faecal and ileal digestibility, caecal activity and carcass characteristics as affected by dietary protein source and microbial phytase supplementation in New Zealand white rabbits. Egyptain Journal of rabbit science, vol. 17 no. 1 pp. 1-26.

Alçiçek, A., M. Bozkurt and M. Çabuk, 2003. The effects of an essential oil combination derived from selected herbs growing wild in Turkey on broiler performance. South African Journal Animal Science, vol. 33 pp. 89-94.

Alçiçek, A., M. Bozkurt and M. Çabuk, 2004. The effects of a mixture of herbal essential oil, an organic acid or a probiotic on broiler performance. South African Journal Animal Science, vol. 34 pp. 217-222.

American Public Health Association, APHA 1960. Standard methods for the examination of dairy products. American published health association 11th edition, New york.

A.O.A.C., 1984. Association of Official Analytical Chemists. "Official Methods of Analysis", 14th ed. Washington, D.C.

A.O.A.C., 1990. Association of Official Analytical Chemists. "Official Methods of Analysis", 15th ed. Published by the AOAC, Washington, D.C.

Bogin, E. and P. Keller 1987. Application of clinical biochemistry of medically relevant animal models and standardization and quality control in animal biochemistry. Journal Clinical Biochemsitry, vol. 25 pp. 873-878.

Bozkurt M., K. Küçükyılmaz, A.U. Çatlı and M. Çınar 2009. Effect of dietary mannan oligosaccharide with or without oregano essential oil and hop extract supplementation on the performance and slaughter characteristics of male broilers. South African Journal of Animal Science, vol. 39 no. 3 pp. 223-232.

CerroneA.,MonettiD.M.,MarianiF.,MennaL.F.,Bartoli M.,Fioretti A.1999Riv.Conigl.,vol.36 pp.47-54.

Cheeke, P.R., N.M. Patton, S.D. Lukefahr and J.I. McNitt, 1987. In: Rabbit Production 6th Ed. Interstate Printers and Publishers. INC.

Conway, E.J. 1958. Micro-diffusion analysis and volumetric error. 4th Edition. The McMillan Co., New York, USA.

Cross D.E., McDevitt R. M ., Hillman K ., Acamovic T., (2007): The effect of herbs and their associated essential oils on performance , dietary digestibility and gut microflora in chickens from 7 to 28 days of age .British poultry Science, vol. 48 pp. 496-506.

Darras, V. M., T. J. Visser, L. R. Berghman and E. R. Kuhn, 1992. Ontogeny of type I and III deiodinase activities in embryonic and posthatch chicks: relationship with changes in plams trriodothyronine and growth hormones level. Comparative Biochemistry and physiology, vol. 103, pp. 131-136.

Denli, M., F. Okan and A.M. Uluocak, 2004. Effect of dietary supplementation of herb essential oils on the growth performance carcass and intestinal characteristics of quail (Coturnix japonica). South African Journal. Animal Science, vol. 34, pp. 174 -179.

Difco Manual 1977. Dehydrated culture media and reagents. Difco laboratories, 8th edition. The McMillan Co., New york.

Dorman, H.J.D. & Deans, S.G., 2000. Antimicrobial agent from plants: antimicrobial activity of plant volatile oils. Journal Applied Microbiology, vol. 88, pp. 308-316.

Doumas, B. T. 1971. Automated analysis beahringer Monnheim. Clinical Acta, pp. 31: 87

Drew, P., R.J.S. Charles, B. Trevor and L. John, 2004. Oxford Handbook of Clinical Haematology. 2th Edition, Oxford University Press, USA. Duncan, D.B. 1955.Multiple range and multiple F tests. Biometrics, vol.11pp.1-42.

Eadie, J.M., P.N. Hobson and S.O. Mann, 1967. A note on some comparisons between the rumen content of barley fed stress and that of young calves also fed on high concentrate rations. Journal Animal Production,vol 9 pp. 247.

El-Ashry, M. A., A. M. El-Serafy, A. Z. El-Basiony and M. F. Sadek, 1993. Probiotic (LBC) in buffalo heifers rations: 1- Effect on productive and reproductive performance. Egyption Journal Animal Production, vol 2; 103

El-Basiony, A. Z., E. E. Ragheb, H. M. El-Nahas and G. A. Abdel Raahman, 2003. A Comparison among some growth promoters for fattening Egyptian buffalo calves. The 9th Scientific Conference on Animal Nutrition, October 2003, Hardaga,. 685

El-Manylawi, M. A., Y. I. El-Talty, N. Y. Abdel-Malak and Hemat, A. Abdel- Magied, 2003. Productive and metabolic traits of growing baladi rabbits fed diets supplemented with medicinal and aromatic plants. The 9th Scientific Conference on Animal Nutrition, October 2003, Horgada 277

El-Manylawi, M. A., M. R. M. Ibrahim; Fatma G. Ahmed and Walaa A. Salama, 2005. Performance of growing rabbits fed diets containing Geranium and Spearmint By-products. Egyptian Journal Rabbit Science, vol. 15, no. 1 pp.13- 26.

El-Raffa, A.M., 2000. Animal model evaluation of V line rabbits raised under Egyptian conditions. Egyptian Journal Poultry Science, vol. 20, pp. 1003-1016

El-Raffa, A.M., 2005. Genetic analysis for productive and reproductive traits of Vline rabbits raised under Egyptian conditions. Egyptian Journal Poultry Science, vol 25, no. IV, pp.1217-1231.

El-Shenawi, A., 1992. Medicate by herbal. Textbook, El-Eman Library, El-Mansoura, Egypt. Fatma, G. A., M. H. Yacout and F. M. Abo-Donia, 2005. Effect of using eucalyptus Globulus leaves in growing rabbits diets. Egyptian Journal rabbit Science, vol. 15, no. 1, pp. 1-11

Feldman, B.F., J.G. Zinkl, and N.C. Jain, 2000. Schalm's Veterinary Hematology. Lippincott Williams and Wilkins, Philadelphia, USA.

Fortun Lamothe L., Boullier S. 2007. A review on the interactions between gut microflora and digestive mucosal immunity. Possible ways to improve the health of rabbits. Livestock Science, vol.107, pp. 1-18.

Fringes, C.S.; T.W. Fendly; R.T. Rum and C.A. Queen 1972. Improved determination of total serum lipids by the soulfo-phospho-vanilin reaction, Clinical Chemistry, vol. 18, pp. 673 - 674.

Galib A. M. Al-Kassie, 2010. The role of peppermint (Mentha piperita) on performance in broiler diets, Agriculture and biology journal of North America, vol. 1, no. 5, pp. 1009-1013.

Gidenne T., Jehl N., Perez J.M., Arveux P., Bourdillon A., Mousset J.L., Duperray J., Stephan S., Lamboley B. 2005. Effect of cereal sources and processing in diets for the growing rabbit. II. Effects on performances and mortality by enteropathy, Animal Research, vol. 54, pp. 65-72.

Gidenne T., Garcia J. 2006. Nutritional strategies improving the digestive health of the weaned rabbit. In: Maertens L., Coudert P (eds). Recent Advances in Rabbit Sciences. ILVO, Animal Science Unit, Melle-Belgium, pp. 229-238.

Gill, C., 1999. Herbs and plant extracts as growth enhancers, Feed International, vol. 20, no. 4, pp. 20-23.

Halle, I., R. Thomann, U. Bauermann, M. Henning and P. Köhler, 2004. Effects of a graded supplementation of herbs and essential oils in broiler feed on growth and carcass traits, Landbauforshung Volkenrode, vol. 54, pp. 219-229.

Hernandez, F., J. Madrid, V. Garcia, J. Orengo and M.D. Megias, 2004. Influence of two plant extracts on broiler performance, digestibility, and digestive organ size, Poultry Science, vol. 83, pp. 169-174.

Horbowicz, M., 2000. Wystpowanie, biosynteza, Wlaoeciwoeci biochemiczne flawonoli, Postçpy Nauk Rolniczych, vol. 2, pp. 3-17.

Ibrahim, A. M., A. A. El-Ghamry and G. M. El-Mallah, 2000. Effect of some medicinal plants of labiatae family as feed additives on growth and metabolic changes of rabbits, Egyptian Journal Rabbit Science, vol. 10, no. 1, pp.105-120.

Jamroz, D. and C. Kamel, 2002. Plant extracts enhance broiler performance. Journal Animal Science, vol. 80, Suppl.1, pp.4. (Abstr.).

Jamroz, D., J. Orda, C. Kamel, A. Wiliczkiewicz, T. Wertelecki and J. Skorupinska, 2003. The influence of phytogenetic extracts on performance, nutrient digestibility, carcass characteristics, and gut microbial status in broiler chickens. Journal Animal Feed Science, vol. 12, pp. 583-596.

Jamroz D. A., Wiliczkiewicz T., Wertelecki T., Orda I., Skorupinska J. 2005. Use of active substances of plant origin in chicken diets based on maize and locally grown cereals. British Poultry Science, vol. 46, pp. 485-493.

Jamroz, D., T. Wertelecki and M. Houszka, 2004. Influence of kind of grain andplant origin active substances on morphological and histochemical pattern of stomach and jejunum walls in chicken. Journal Animal Physics Nutrition.

Krieg R., W. Vahjen, W. Awad, M. Sysel, S. Kroeger, E. Zocher, H.W. Hulan, G. Aarndt, J. Zentek, 2009. Performance, digestive disorders and the intestinal microbiota in weaning rabbits are affected by a herbal feed additive. World Rabbit Science, vol. 17, pp. 87 – 95 © WRSA, UPV, 2003 87

Langhout, P., 2000. New additives for broiler chickens.World Poultry Elsevier, vol.16, no. 3, pp. 22-27.

Lebas F., Gidenne T., Perez M.J., Licois D. 1998. Nutrition and Pathology. In: de Blas C. and Wiseman J (eds). The Nutrition of the Rabbit. CABI, Oxfordshire, UK, pp. 197- 214.

Lee, K.W., H. Everest, H.J. Kappert, K.H. Yeom and A.C. Beynen, 2003. Dietary Carvacrol lowers body weight gain but improves feed conversion in female broiler chickens. Applied Poultry Research, vol. 12, pp. 394-399.

Mackie, T. J. and Me-Carteny, J. E. 1953. Handbook of practical bacteriology. A guide to bacteriological laboratory work. 9th edition, Livingstone Ltd, Edinburgh.

Madrid, J., F. Hernandez, V. Garcia, J. Orengo, D. Magias and V. Savilla, 2003. Effect of plant extracts on ileal apparent digestibility and carcass yield in broilers at level of farm. 14th European Symposium Poultry Nutrition, August 10-14, Norway. pp. 187-188.

Micini, G., A.O. Garbonara, and H. Harmans (1965). Immunochemical guantitation of antigen by single radial immunodiffusion. Immunochemistry, vol. 2, pp. 235-242.

Mitruka, B.M. and H.M. Rawnsly, 1977. Clinical Boichemical and Hematological referance values in normal experimental Animal masson publishing USA. Inc.

National Research Council (NRC), 1994. Nutrient Requirements of Poultry 9th Edn. National Academy Press, Washington, DC. of Alletchs 10th Annual Symposium. Nottingham University Press, Nottingham, UK.

Ocak, N., G. Frener, F. Burak, A.K.M. Sungu, A. Altor and Spring, A. Ozmman, 2008. Performance of broilers fed diets with dry peppermint (Mentha piperita L.) or thyme (Thymusulgaris L.) leaves as promoter source, Animal Science, vol. 53, pp. 169-175.

Radwan, M. A., G. A. Abd-Allah, H. M. Fayek and M. A. Breiweek, 1995. The effect of three types of feed additives on the productive performance of layers. First Egyptian Hungarian Conference, Alexandria, Egypt. SAS, 1999. Statistical Analysis System (SAS) user's Guide; Statistics. SAS institute Inc. Editors, Carry, Nc

Sharma, R. D. 1984. Hypocholesterolemic activity of fenugreek (T. foenum graecum). An experimental study in rats. Nutrition Reports International, vol. 30 no. 1, pp. 221-231.

Teodorovic, M., A. Sreckovic, J. Tot, F. Kajari and L. Dragic, 1990. Efficacy of fito-diaro-stop in treating and preventing diarrhoea in piglets. Veterinarski-Glasnik, vol. 44, no.8, pp. 681-687.

Trinder, P. (1969). Colorimetric method for the determination of blood glucose. Animal Clinical Biochemistry, vol. 6, pp. 24.

Ultee, A., Kets, E.P.W. & Smid, E.J., 1999. Mechanisms of action of carvacrol on the food borne pathogen Bacillus cereus. Applied Environmental Microbiological, vol. 65, pp. 4606-4610.

Wang, R. J., D. F. Li and B. Steve. 1998. Can 2000 years of herb medicine history help us solve problems in the year 2000. In: Biotechnology in the feed industry (Ed. T. P. Lyons and K. A. Jacques). Nottingham University Press. pp. 271-291

Wieslaw, P.S., Krystyna, M. Charon, Anna Winnicka and Joanna Gruszczynska (2006). Relationship between blood lymphocyte phenotype, drb 1 (mhc class ii) gene polymorphism and somatic cell count in ewe milk. Bulletin of the Veterinary Institute in Pulawy, 50: 73-77.

www.info@micro-plus.com

Zeid, A. M. 1998. Effect of using medicinal plants on goat’s performance. Ph. D. Thesis, Faculty of Agriculture, Cairo University. Cairo, Egypt.

Zhang, K.Y., Yan, F., Keen, C.A. & Waldroup, P.W., 2005. Evaluation of microencapsulated essential oils and organic acids in diets for broiler chickens. International Journal Poultry Science, vol. 4, no. 9, pp. 612-619.