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EFFECT OF FENNEL, THYME AND PROBIOTIC AS FEED ADDITIVES ON THE PERFORMANCE AND THE MICROBIAL CONTENT OF THE INTESTINE OF MUSCOVY DUCKS

by

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Abstract: *This study was conducted to investigate the effect of fennel , thyme and probiotic (Livesac) supplementation on the productive performance, nutrints digestibility , plasma components, carcass characteristics and intestinal microbial content of the Muscovy ducks. A total number of 224 one-day Muscovy ducklings were divided into eight treatment groups of 28 birds each (12 males and 16 females), each group was subdivided into four replicates of 7 birds (3 males and 4 females) each . The basal starter and grower/finisher (T1) diets were supplemented with either fennel fruits (0.5%, T2 and 1.0%,T3), thyme leaves (0.5%, T4 and 1.0%,T5), mixture 1:1 of fennel and thyme (0.5%, T6 and 1.0%, T7) or a commercial probiotic (Livesac 0.05%,T8). The basal diets contained 22% CP and 2900 Kcal ME/kg during the starting period (0-4 weeks of age) and 19% CP and 3000 Kcal ME/kg during the growing and finishing period (5-10 weeks of age).*

Results showed that adding herbs (fennel or thyme) to the control diet significantly improved (P<0.05) BW, BWG, FCR and PI at the first period (0-4 wks). While , probiotic did not improve BW , BWG, FI, FC and PI at the same period (0-4 wks).At the second period (5-10 wks), the herbs and probiotic had no effect on the productive performance. Supplementing fennel and thyme with 1.0% were better than 0.5% while, supplementing the mixture of them at 0.5% were better than 1.0% on productive performance of ducks. The best duck performance obtained from supplementing 1.0% fennel (T3) and mixture of fennel and thyme at 0.5% (T6) .Carcass characteristics revealed no significant differences in dressing % , liver %, edible giblets and empty gizzard. While, the high levels either of fennel or

thyme (1.0%) recorded the lowest value of abdominal fat compared with the low level (0.5%) of each . Moreover, probiotic recorded the worst value of abdominal fat. The results of digestion coefficient indicates that no significant differences (P<0.05) were detected among treatments in OM, EE and NFE except T6 (herbal mixture at 0.5%) and T8 (probiotic at 0.05%) which recorded the highest values (P<0.05) compared with the control group. However, the addition of 1.0% fennel or thyme (T3or T5) , the mixture of them (T6 and T7) and probiotic group revealed significant digestibility of CP and CF compared with the basal diet (T1). The addition either of fennel, thyme or their mixture as well as probiotic did not affect the meat content of CP and EE. Plasma total protein , albumin and globulin significantly increased in T3 (fennel at 1.0%) and probiotic (T8) compared to control group. Plasma cholesterol was significantly decreased in T6 (0.5% mixture) compared with the control and probiotic groups. Triglyceride and createnine were decreased among all groups compared to control and probiotic groups . In addition, GOT was decreased by adding all levels of fennel or thyme compared to control and probiotic groups , while GPT decreased by using low levels of fennel or thyme (T2 and T4). The total count of duck ileum and caecum were significantly lower by adding mixture of fennel and thyme (T6 and T7) than other treatments or control groups. Also, same trend was obtained from some microbial groups such as proteolytic bacteria, cellulose digesters and libolytic bacteria in the duck's ileum and ceacum. The economical efficiency study showed that ducks fed diets containing 1.0% fennel (T3) and 0.5% mixture (T6) recorded better economical efficiency values than those of other treatments.

It could be concluded that, the addition of fennel fruits or thyme leaves at 1.0% or mixture of them at 0.5% can improve the productive performance of Muscovy duck particulary during the starter period (0-4 wks).

INTRODUCTION

Nowadays, there is a tendency to use herbs and probiotics as natural feed additives to avoid the residual cumulative effects for either antibiotics or synthetic drugs in final products of poultry, which have negative effects on the human health.

Probiotics have been used for animals and poultry as feed additives or as growth promoter to replace the widely used antibiotics and synthetic chemical feed supplements with positive statistical effects on growth performance (**Onifade *et al.*, 1999)** and egg production properties **(Mohan**

***et al*., 1995 , Mona Osman, 2003 , Kout El-kloub Moustafa, 2006).** Furthermore, probiotics effects may be mediated by a direct antagonistic effect against specific groups of organisms, resulting in a decrease in their number **(Watkins, 1981; Watkins *et al*., 1982; and Hentges, 1983)** or by an effect on their metabolism **(Rantala and Nurmi, 1973 and Goldin and Gorbach, 1984)** or by stimulation of immunity **(Parker, 1974 and Umesb, 1999)**. Moreover, **Endo *et al*., (1999**) revealed that the incorporation of probiotics in the diets would improve the balance of the intestinal flora and metabolites in cocks.

Herbs have been used as human food and for medicinal purposes for centuries. Recently , it has been found that, herbs and edible plants given to animals or birds improve their physiological and productive performance.

Khodary *et al*., (1996) carried out some experiments and reported the efficiency of herbs, edible plants and some plant seeds as a natural tonic, restoratives, antibacterial, and antiparasitic drugs on improving the productive performance in poultry.

Craig (1999) reported that thyme is one of the herbs that provide substantial amounts of flavonoids which have health promoting properties, as they extend the activity of vitamin C, acts as antioxidants, protect LDL cholesterol from oxidation, stimulate the immune system and acts as anti-inflammatory and antitumor agents .

Herbal growth promoter (thyme or fennel) had significant improvement of body weight, weight gain, mortality rate and feed conversion **(Abd El-Malak,*et al*., 1995, Ibrahim,*et al*., 1998, and Tollba and Hassan, 2003)** with broilers, **Ghazalah and Faten Ibrahim (1996)** with ducks and **Abd El-Latif, *et al*., (2002)** with Japanese quails**.**

This study was aimed to evaluate the effect of fennel and thyme as natural feed additives and probiotic in diets of Muscovy ducks on productive performance .

MATERIALS AND METHODS

Feeding trials of the present study were conducted at Poultry Experimental Farm belonging to Environmental Studies and Research Institiute, Minufiyia University, Sadat City, Egypt. The laboratory work was carried out at the Poultry Nutrition Department, Animal Production Research Institute, Agriculture Research Center, Ministry of Agriculture, Dokki, Giza, Egypt.

A total number of 224 one-day old Muscovy ducklings were used in this study. They were nearly similar in initial body weight (about 270 ± 4.33 g).

The birds were randomly divided into eight equal experimental groups of 28 birds each (12 males and 16 females), each group was subdivided into four replicates of 7 birds (3 males and 4 females). Ducklings of each replicate were housed in floor pen. The basal diets contained 22% CP and 2900 Kcal ME/kg during the starting period (0-4 weeks of age) and 19% CP and 3000 Kcal ME/kg during the growing and finishing period (5-10 weeks of age) as listed in Table (1).

The basal diets (starter and grower/finisher,T1) were supplemented with either fennel fruits (0.5%, T2 and 1.0%,T3), thyme leaves (0.5%, T4 and 1.0%,T5), mixture 1:1 of fennel and thyme (0.5%, T6 and 1.0%, T7) or a commercial probiotic (Livesac 0.05%,T8).

The eight groups of ducklings were fed the eight experimental diets for 10 weeks experimental period (4wks starter period and 6 wks grower/finisher period). All birds reared under similar managerial and veterinarian conditions.

Live body weight (BW) and feed intake (FI), body weight gain (BWG), feed conversion ratio (FCR) and performance index (PI) were calculated at 4 and 10 weeks of age.

The nutrients digestibility coefficients of the experimental diets were determined using 3 males of each group at 10 wks of age (at the end of the experiment), and housed individually in metabolism cages.

At the end of the experiment, six birds (3 males and 3 females) from each treatment were taken randomly for slaughter test and carcass weights were calculated as percentage of live body weight.

Blood samples were obtained from wing vein of 3 ducks within each treatment at 10 weeks of age for determination of plasma total protein, albumin, transaminase enzyme activities (GOT and GPT), total cholesterol, triglycerides and creatinine using available commercial kits .

Chemical analysis was carried out as described in **AOAC (1980).** Fecal Nitrogen was evaluated according to **Jakobsen *et al*. (1960).** Urinary organic matter was evaluated according to **Abou-Raya and Galal (1971).**

Three male birds from the slaughtered ducks within each treatment were used to define and count the microbial content of the gastrointestinal

tract (ileum and ceacum) as affected by the tested additives. Also, three samples from each of the experimental diets were analyzed for their microbial contents (total counts, total coliform and molds) .

The microbial content was studied , as described by **Postage (1969)** for total viable counts of bacteria, **Fuller and Normans (1943) and Kopecny and Simunek (2002)** for cellulose decomposers , **Smith *et al*., (1952)** for proteolytic bacteria, **Berry (1933)** for lipolytic bacteria, **Difco (1989)** for molds, coliform , E.coli and Salmonella were enumerated according to the methods described by **AOAC (1980)**.

The obtained data were statistically analyzed using linear models procedure described in SAS user's guide **(SAS, 1990)**. Differences among means were tested using Duncan's multiple range test **(Duncan, 1955).**

RESULTS AND DISCUSSION

Productive Performance:

The effects of fennel , thyme , and probiotic on Muscovy ducks performance are shown in Table (3). Results showed that adding herbs (fennel or thyme) to the control diet significantly improved ($P<0.05$) BW, BWG, FCR and PI at the first period (0-4 wks) . The improvement in BWG may be due to the presence of fat soluble unidentified factor and vitamin F group (a mixture of essential fatty acids including linoleic, linolenic and arachidonic acids) in the supplemented herbal feed additives which have been essential for growth **(Murray *et al*., 1991)**. These results agreed well with **(Abd El-Malak,*et al.,* 1995, Ibrahim,*et al.,* 1998, Tollba and Hassan 2003)** with broiler, **Ghazalah and Faten Ibrahim (1996)** with ducks and **Abd El-Latif, *et al.,* (2002)** with Japanese quails**.** Also, FI was improved ($P<0.05$) by adding these feed additives except fennel and thyme mixture (0.5 or 1.0%) at the first period (0-4 wks) compared with the control and probiotic groups. Results of FCR and PI showed significant improvement by supplementing fennel and thyme or their mixture at the first period of growth . While , supplementation of the probiotic did not improve BW , BWG, FI, FC and PI at the same period (0-4 wks). In contrary, **Yeo and Kim (1997)** indicated that dietary probiotic may decrease urease activity in the small intestinal content of young chick and may be beneficial for improving poultry health and growth especially during the early life. However, the beneficial effects of supplemented fennel and thyme or their mixture may be due to the stimulation of appetite and feed intake, the improvement of endogenous digestive enzyme secretion, activation of immune response and antibacterial, antiviral, antioxidant and antihelminthic actions **(Jamroz *et al*.,2003).** On the other hand, at the second period (5-10

wks), the tested herbs and probiotic had no effect on the productive performance.

Generally, supplementing fennel and thyme at 1.0% were better than at 0.5% while, supplementing the mixture of them at 0.5% was better than at 1.0% on productive performance of ducks. As overall trend, the best duck performance obtained from supplementing fennel at 1.0% (T3) and mixture of fennel and thyme at 0.5% (T6) .

Carcass characteristics:

The results of carcass traits of Muscovy ducks by adding herbs (fennel, thyme and their mixture1:1) and probiotic are tabulated in Table (4). The data revealed that no significant differences were shown in dressing % , liver %, edible giblets % and empty gizzard % .Same trend were obtained by **Abdel-Malak *et al.* (1995), Abaza (2001) and Tollba and Hassan (2003).** A significant increase in heart % was observed by feeding diet containing 0.5% and 1.0% thyme and 0.5% thyme + fennel mixture (T6). While, a significant decrease in abdominal fat % was recorded for groups fed the herbal (fennel or thyme) compared with control or probiotic groups. In addition, the higher levels of fennel or thyme (1.0%) recorded the lowest value of abdominal fat compared with the corresponding low levels (0.5%) of each.

Digestion coefficients:

The results of digestion coefficient indicate that no significant differences ($P<0.05$) among treatments in OM, EE and NFE except T6 (0.5% mixture) and T8 (0.05% probiotic) which recorded the corresponding highest values ($P<0.05$) compared with the control group (Table 5). However, the addition of 1% fennel or thyme (T3or T5) , the mixture of them (T6 and T7) and probiotic group revealed significant higher digestibility of CP and CF compared with the basal diet (T1). The beneficial effects of adding these herbs may be due to the improvement of endogenous digestive enzyme secretions as reported by **Jamroz *et al*., (2003).** These results are generally in accordance with those obtained by **El-Ghamry (1998)** who found that digestion coefficient of CP, EE, NFE and CF for groups of birds fed diets containing 6.2% Nigella Sativa meal were similar to the control . While, **Abdel-Azeem *et al*., (1999)** reported that the digestion coefficients of DM, OM, CP, CF and EE were significantly increased by supplementing black seeds up to 2% in growing rabbit diets. Nevertheless, **Abou-Egla *et al*., (2001)** showed that quails fed diet

containing black cumin meal at level of 2.3% were more efficient in digesting of CP than the control group by 3.7%.

In general, the best digestibility results of nutrients digestibility were obtained from the addition of 1.0% fennel or thyme (T3 or T5) while, the mixture of them at 0.5% (T6) surpassed all other treatments.

Chemical composition of meat:

Table (6)showed, in general, that the addition of fennel, thyme, mixture of them and probiotic did not affect the CP and EE content of the meat on dry matter bases . Similarly, **Soliman *et. al.*, (1999)** found the same trend in chemical composition of meat when they used black seed in broiler diets. Also, logical results were obtained for the effect of all additives on birds meat where, males were higher in crude protein than females, while, females meat had higher ether extract than males. However, the front part had significantly ($P<0.05$) higher CP and lower EE content than front part.

Blood constituents:

The data obtained for the values of blood plasma constituents of Muscovy ducks as affected by different feed additives are shown in Table (7). Plasma total protein and albumin were slightly affected by adding herbs. Plasma globulin insignificantly increased by added herbs while, T3 significantly increased than control and surpassed all dietary treatments . Increasing globulin may be due to the immunostimulant effect of thyme or fennel . **Tollba *et al.*, (2005)** observed similar results when added 2% thyme or black seed to laying hen diet, also, **Tollba and Hassan (2003)** found that added 1% thyme or fennel to broiler diets increased total protein as well as albumin and globulin. Moreover, probiotic supplementation increased total protein , albumin and globulin compared to control group. Plasma cholesterol was insignificantly decreased for groups fed fennel or thyme except T6 (mixture of fennel and thyme at 0.5%) which recorded the best value ($P<0.5$) compared with the control and probiotic groups. Triglyceride and createnine were decreased among all groups compared to control and probiotic groups . Nevertheless, **Tollba and Hassan (2003)** showed that broilers fed diet containing fennel or thyme at level of 1% had no significant change in createnine value. In addition, GOT was decreased by adding all levels of fennel or thyme compared to control and probiotic groups , while, GPT decreased by using low level of fennel or thyme (T2 and T4). The decreasing of enzyme activity and non-changing on the relative weights of liver exhibit healthy, non-pathological and non-toxic effect of thyme or fennel on liver or kidney functions. Similar results were obtained by **Tollba and Hassan (2003)** when added fennel and thyme as feed additives in

broiler diet and **Abdel-Malak, *et al*.(1995)** when added biotonic as herbal feed additive. Also, **Afifi (2001)** when added 2 or 3 % Nigella sativa seeds and reported that GPT and GOT activity significantly (P<0.05) decreased.

Microbiological evaluation:

Table (8) showed the effect of fennel , thyme, mixture of fennel and thyme and probiotic on microbial groups and bacterial species count of Muscovy ducks ileum and caecum . The total count of duck ileum and caecum were significantly lower by adding mixture of fennel and thyme (T6 and T7) than other treatments or control groups. This reduction may be due to the associative antimicrobial effect of fennel and thyme. Similar results were reported by **Khodary *et al*., 1996** , **Jamroz *et al*.,2003 and Pina-Vaz et al.,2004.** Also, same trend was obtained from some microbial groups such as proteolytic bacteria, cellulose digesters and libolytic bacteria in the duck's ileum and ceacum. The same results were obtained by using marjoram supplementation in broiler diets **(Soliman et al., 2003)**. Groups fed diets containing 0.5 and 1.0% fennel or thyme resulted in cleaning the ileum and ceacum from *Salmonella* compared with a few number of *Salmonella* cells which were recovered from ileum or caecum of other groups . In this regard , **Soliman *et al.*(2003)** observed that marjoram and yeast in broiler diets resulted in cleaning the gastro intestinal tract from *Salmonella*. The counts of *E.coli* were significantly (P<0.05) reduced due to diets containing mixture of fennel and thyme at 0.5 or 1.0% in both ileum and caecum of ducks compared with other tested and control groups. In this concern, **Cowan (1999)** reported that plants are rich in a wide variety of secondary metabolites, such as terpenoids , which was found to have antimicrobial properties. Also, these results were supported by **Soliman et al. (2003)** who reported that marjoram supplementation at 1.5% to broiler diets causes the most reduction of *E.coli* in gastro-intestinal tract of broilers.

The antimicrobial effect of fennel , thyme and their mixture were supported by the results of the microbial content of the experimental diets (Table 9) where the counts of total coliform and molds as well as the total bacterial count were significantly (P<0.05) decreased in diets contained mixture of fennel and thyme at levels of 0.5 and 1.0%, as compared to control and probiotic groups. The values were decreased by 31.48, 55.96 and 54.27% for total counts, total coliform and molds, respectively, for group contained 0.5% (fennel and thyme) mixture compared with the control group. Same trend was obtained from the diet contained 1.0% fennel and thyme mixture . Total coliform and molds were significantly decreased in all experimental diets compared with the control and probiotic groups,

these results were supported by **Soliman *et al*. (2003)** who reported that the use of marjoram (1.5%) in broiler diet decreased the total counts, total coliform and yeasts in diets. In this concern, **Khodary *et al*., 1996** , **Jamroz *et al*.,2003 and Pina-Vaz *et al*.,2004** detected antimicrobial properties as well as biological activities of herbs .

Economic Efficiency:

The efficiency (Table 10) showed that the group fed 1.0% fennel (T3) achieved the best value of net revenue followed by group fed 0.5% mixture (T6) compared to control group (15.99 , 15.46 and 14.64 LE , respectively). Duck fed diets containing 1.0% fennel (T3) and 0.5% mixture (T6) recorded better economical efficiency values than those of other treatments. This results agreed well with the previous findings. Of Abd El-Latif et al.,(2002)who reported that, the profitability of adding medicinal additives (i.e thyme, black cumin, dianthus and fennel at level 1 kg/ton) reduced the feed cost of 1 kg weight gain. However, T8 (0.5%probiotic) recorded the worst value of economic efficiency compared with control and other treatments.

From the results obtained, it could be concluded that the addition of fennel fruits or thyme leaves at 1.0% or mixture of them at 0.5% can improve the productive performance of Muscovy ducks.

Table (1) : Composition and calculated analysis of starter and grower\finisher experimental diets given to Muscovy ducks

Ingredients	Starter period 0-4 wks %	Grower\finisher period 5-10wks %
Corn yellow	55.70	61.30
Soybean meal (44%)	34.90	29.00
Corn gluten meal (60%)	3.80	3.00
Soybean oil	1.80	2.88
Di-calcium phosphate	2.00	1.90
Limestone	0.70	0.80
DL-Methionine	0.10	0.13
Premix *	0.30	0.30
Choline chloride (50%)	0.25	0.25
Sodium bicarbonate	0.25	0.24
Nacl	0.20	0.20
Total	100	100
Calculated values**		
Crude protein %	22.06	19.41
ME kcal/kg	2938	3057
Calcium %	0.86	0.85
Available P	0.52	0.49
Methionine	0.50	0.49
Lysine	1.20	1.03
Meth+Cys	0.86	0.81

* Vitamins and minerals premix provides per kilogram of diet: 10500 IU vitamin A, 11.0 IU vitamin E, 1.1 mg menadione (as menadione sodium bisulfite), 2100 ICU vitamin D3, 5 mg riboflavin, 12 mg Ca pantothenate, 12.1 µg vitamin B12, 2.2 mg vitamin B6, 2.2 mg thiamin, 44 mg nicotinic acid, 250mg choline chloride, 1.55 mg folic acid, 0.11 mg d-biotin. 60 mg Mn, 50 mg Zn, 0.3mg I , 0.1 mg Co, 30 mg Fe,5mg Cu and 3 mg Se.

** Calculated according to NRC (1994).

Table (2) Chemical composition of fennel and thyme on DM basis.

Item %	**Fennel fruits**	**Thyme leaves**
Moisture	13.11	12.13
Dry matter (DM)	86.89	87.87
Organic matter (OM)	83.75	84.45
Crude protein (CP)	23.60	18.14
Ether extract (EE)	8.31	10.57
Crude fiber (CF)	13.16	16.79
Ash	16.25	15.55
Nitrogen free extract (NFE)	25.57	26.82
Acid insoluble ash*	1.25	2.62
Volatile oil*	2.38	2.84

*Analysis were done at Ottoman for Trad. & Manufact. (Royal for Herbs) Shbramant, Giza , Egypt

Table : (3) Performance of Muscovy ducks as affected by different levels of fennel and thyme as feed additives.

Item	T1	T2	T3	T4	T5	T6	T7	T8	±SEM
Initial BW(g)	270.93	271.58	269.63	272.83	271.42	270.44	267.76	270.21	
BW(Kg) :									
4 wks	1.13 ^{e}	1.42 ^{b}	1.53 ^{a}	1.28 ^{c}	1.41 ^{b}	1.50 ^{a}	1.25 ^{cd}	1.17 ^{de}	0.04
10 wks	3.07 ^{abc}	3.09 ^{abc}	3.37 ^{a}	2.69 ^{c}	3.03 ^{ab}	3.35 ^{a}	2.87 ^{bc}	3.17 ^{ab}	0.11
BWG (Kg):									
0-4 wks	0.86 ^{e}	1.15 ^{ab}	1.26 ^{a}	1.01 ^{c}	1.13 ^{b}	1.23 ^{a}	0.98 ^{cd}	0.90 ^{de}	0.04
5-10 wks	1.94 ^{ab}	1.67 ^{bcd}	1.84 ^{bc}	1.40 ^{e}	1.63 ^{cde}	1.85 ^{bcd}	1.63 ^{de}	2.00 ^{a}	0.10
0-10 wks	2.80 ^{abc}	2.82 ^{abc}	3.10 ^{a}	2.42 ^{d}	2.76 ^{bcd}	3.08 ^{a}	2.61 ^{cd}	2.90 ^{ab}	0.11
FI (Kg):									
0-4 wks	3.05 ^{c}	2.74 ^{e}	2.64 ^{e}	2.93 ^{cd}	2.80 ^{de}	3.33 ^{b}	3.14 ^{c}	3.61 ^{a}	0.07
5-10 wks	6.54 ^{c}	7.37 ^{cd}	7.81 ^{c}	6.68 ^{e}	7.1 ^{de}	7.59 ^{cd}	8.40 ^{b}	9.11 ^{a}	0.18
0-10 wks	9.60 ^{cd}	10.11	10.45 ^{bcd}	9.61 ^{c}	9.99 ^{cd}	10.92 ^{bc}	11.54 ^{b}	12.72 ^{a}	0.40
FCR:									
0-4 wks	3.55 ^{b}	2.38 ^{e}	2.10 ^{f}	2.9 ^{cd}	2.48 ^{e}	2.71 ^{de}	3.20 ^{c}	4.01 ^{a}	0.11
5-10 wks	3.37 ^{b}	4.41 ^{ab}	4.25 ^{b}	4.77 ^{ab}	4.41 ^{ab}	4.10 ^{b}	5.15 ^{a}	4.56 ^{b}	0.89
0-10 wks	3.43 ^{bc}	3.59 ^{cd}	3.37 ^{d}	3.97 ^{bc}	3.62 ^{cd}	3.55 ^{cd}	4.42 ^{a}	4.39 ^{ab}	0.18
PI:									
0-4 wks	31.94 ^{d}	61.43 ^{b}	73.45 ^{a}	47.01 ^{c}	57.81 ^{b}	56.30 ^{b}	39.24 ^{cd}	29.35 ^{d}	3.31
5-10 wks	70.61 ^{a}	61.47 ^{ab}	67.78 ^{a}	43.45 ^{b}	58.96 ^{ab}	67.85 ^{a}	45.90 ^{b}	64.61 ^{a}	6.28
0-10 wks	83.01 ^{abc}	90.14 ^{ab}	101.52 ^{a}	71.14 ^{c}	85.82 ^{abc}	97.86 ^{a}	68.06 ^{c}	73.32 ^{bc}	6.10

-T1=control, T2=0.5%fennel, T3=1.0%fennel, T4=0.5%thyme, T5=1.0%thyme, T6=0.5%(fennel+thyme), T7=1.0%(fennel+thyme), T8= 0.05%probiotic(Livesac)

-BW= body weight, BWG= body weight gain, FI=feed intake, FCR=feed conversion ratio, PI=performance index

$^{ab...}$ Means within a row with no common superscripts differ significantly (P≤0.05) based on Duncan's separation of means.

- SEM= Standard Error Mean

Table (4): Carcass characteristics values of Muscovy ducks as affected by the tested feed additives.

Parameters	T1	T2	T3	T4	T5	T6	T7	T8	±SEM
Live body weight (g)	3183.33^{b}	3191.67^{b}	3291.67^{ab}	3400.00^{a}	2941.67^{c}	3408.33^{a}	3508.33^{a}	3400.12^{a}	140.68
Carcass weight (g)	2155.07^{b}	2166.48^{b}	2349.11^{ab}	2335.43^{ab}	2045.63^{b}	2318.37^{ab}	2391.39^{ab}	2235.02^{ab}	127
Dressing %	68.06^{a}	67.94^{a}	71.32^{a}	69.01^{a}	69.37^{a}	67.22^{ab}	68.29^{a}	54.82^{b}	1.23
Total giblets %	9.18^{b}	10.21^{b}	9.57^{b}	10.59^{b}	15.96^{a}	9.77^{b}	8.02^{b}	8.93^{b}	1.20
Edible giblets %	5.12^{a}	5.36^{a}	5.14^{a}	5.31^{a}	5.25^{a}	4.84^{ab}	4.62^{ab}	3.541^{b}	0.23
Abdominal fat %	7.80^{a}	6.15^{b}	4.62^{c}	4.18^{cd}	2.84^{ef}	3.49^{de}	1.83^{f}	7.76^{a}	0.34
Liver %	2.54	2.59	2.54	2.70	2.69	2.41	2.30	2.40	0.18
Heart %	1.29^{d}	1.45^{bcd}	1.39^{cd}	1.55^{bc}	1.83^{a}	1.66^{ab}	1.47^{bcd}	1.36^{bc}	0.07
Gizzard %	2.87^{ab}	2.95^{a}	2.87^{ab}	2.64^{ab}	3.02^{a}	3.10^{a}	2.45^{bc}	1.72^{c}	0.15
Empty gizzard%	2.47^{ab}	2.49^{ab}	2.43^{ab}	2.20^{b}	2.49^{ab}	2.71^{a}	2.16^{b}	1.45^{c}	0.13

-T1=control, T2=0.5%fennel, T3=1.0%fennel, T4=0.5%thyme, T5=1.0%thyme, T6=0.5%(fennel+thyme), T7=1.0%(fennel+thyme), T8= 0.05%probiotic(Livesac)

$^{ab....}$ Means within a row with no common superscripts differ significantly (P≤0.05) based on Duncan's separation of means.

- SEM= Standard Error Mean

Table (5) : Nutrients digestibility of experimental grower/ finisher diets.

Treatments	Digestion coefficients				
	OM	CP	EE	CF	NFE
T1 control	73.31^{b}	67.53^{b}	81.98^{cd}	23.99^{c}	84.14^{b}
T2	74.35^{b}	63.45^{b}	72.37^{e}	24.19^{c}	86.48^{ab}
T3	79.34^{ab}	79.75^{a}	83.71^{bcd}	31.37^{cb}	86.875^{ab}
T4	73.37^{b}	66.97^{b}	80.13^{d}	28.11^{c}	82.19^{b}
T5	78.70^{ab}	78.86^{a}	83.68^{bcd}	38.52^{b}	84.04^{b}
T6	86.23^{a}	85.10^{a}	88.16^{a}	52.36^{a}	90.10^{a}
T7	80.82^{ab}	79.11^{a}	84.91^{abc}	37.88^{b}	86.76^{ab}
T8	86.95^{a}	83.99^{a}	87.48^{ab}	57.99^{a}	89.54^{a}

-T1=control, T2=0.5%fennel, T3=1.0%fennel, T4=0.5%thyme, T5=1.0%thyme, T6=0.5%(fennel+thyme), T7=1.0%(fennel+thyme), T8= 0.05%probiotic(Livesac)

$^{ab....}$Means within a column with no common superscripts differ significantly (P≤0.05) based on Duncan's separation of means.

Table (6) : Meat composition (CP and EE) of Muscovy ducks as affected by the tested feed additives

Item	CP	EE
Treatments:		
T1 control	59.71	32.08
T2	59.60	32.41
T3	59.31	33.88
T4	60.67	32.43
T5	59.45	33.21
T6	60.00	33.62
T7	60.85	33.40
T8	61.74	31.61
Standard Error Mean	±1.62	±1.65
Sex:		
Male	65.38^{a}	26.01^{b}
Female	53.70^{b}	38.01^{a}
Standard Error Mean	±0.81	±0.82
Parts:		
Front	65.15^{a}	26.89^{b}
Hind	53.94^{b}	38.09^{a}
Standard Error Mean	±0.81	±0.82

-T1=control, T2=0.5%fennel, T3=1.0%fennel, T4=0.5%thyme, T5=1.0%thyme, T6=0.5%(fennel+thyme), T7=1.0%(fennel+thyme), T8=0.05%probiotic(Livesac)

$^{ab....}$Means within a column with no common superscripts differ significantly (P≤0.05) based on Duncan's separation of means.

Table (7) : Blood plasma constituents of Muscovy ducks as affected by the tested feed additives

Paramete	T1	T2	T3	T4	T5	T6	T7	T8	±SEM
TP	4.30^{bc}	3.33^{cd}	4.91^{ab}	4.91^{ab}	3.48^{cd}	4.27^{bc}	2.72^{d}	5.88^{a}	0.35
AL	3.08^{abc}	1.74^{d}	2.89^{abc}	3.43^{ab}	2.41^{bcd}	2.83^{abc}	2.04^{cd}	3.74^{a}	0.32
GL	1.22^{cd}	1.59^{abc}	2.02^{ab}	1.48^{bc}	1.07^{cd}	1.45^{bc}	0.68^{d}	2.15^{a}	0.18
Ch	151.33^{ab}	145.17^{abc}	138.33^{bc}	147.17^{abc}	138.67^{bc}	128.00^{c}	135.67^{bc}	164.00^{a}	6.03
TG	148.83^{b}	144.41^{bc}	138.38^{cde}	136.62^{bcd}	127.07^{e}	138.72^{cd}	132.75^{de}	163.12^{a}	2.5
CR	1.42^{b}	0.96^{cde}	0.98^{cde}	1.14^{bcd}	0.92^{de}	1.29^{bc}	0.79^{e}	1.75^{a}	0.11
GOT	7.92^{ab}	5.67^{bcd}	5.00^{cd}	5.33^{bcd}	7.00^{bc}	5.17^{cd}	3.83^{d}	10.13^{a}	0.82
GPT	8.67^{cde}	6.33^{e}	10.33^{bcd}	7.33^{de}	13.33^{b}	12.33^{bc}	12.83^{b}	17.25^{a}	1.18

-T1=control, T2=0.5%fennel, T3=1.0%fennel, T4=0.5%thyme, T5=1.0%thyme, T6=0.5%(fennel+thyme), T7=1.0%(fennel+thyme), T8=0.05%probiotic(Livesac)

-TP=Total protein, AL=Albumin, GL=Globulin, Ch=Cholesterol, TG=Triglyceride, CR=Createnine

[ab,....]Means within a row with no common superscripts differ significantly (P≤0.05) based on Duncan's separation of means.

- SEM= Standard Error Mean

Table (8): The effect of fennel, thyme and their mixture as well as the probiotic on microbial groups counts and specific bacterial species (log 10 CFU G-1 fluid) of ileum and cecum of muscovy ducks.

Parameters	Treatments								
	T1	T2	T3	T4	T5	T6	T7	T8	±SEM
Total counts:									
Illium	14.53^{c}	16.02^{b}	13.47^{d}	16.60^{a}	12.99^{e}	12.12^{f}	11.70^{f}	16.08^{b}	0.15
caecum	15.75^{b}	15.95^{b}	15.49^{b}	16.83^{a}	14.83^{c}	12.28^{d}	10.60^{e}	15.40^{bc}	0.19
Proteolytic bacteria:									
Illium	4.70^{b}	5.85^{a}	5.97^{a}	5.75^{a}	5.68^{a}	4.80^{b}	3.04^{c}	5.82^{a}	0.13
caecum	5.13^{cd}	2.82a^{b}	6.36^{a}	5.86^{ab}	5.63^{bc}	4.64^{d}	3.79^{e}	4.91^{d}	0.18
Cellulose digesters:									
Illium	4.35^{e}	6.39^{b}	6.36^{b}	6.93^{a}	5.16^{d}	5.29^{cd}	3.44^{f}	5.76^{c}	0.12
caecum	5.25^{b}	6.45^{a}	5.41^{b}	6.75^{a}	5.62^{b}	5.31^{b}	3.25^{c}	5.58^{b}	0.18
Libolytic bacteria:									
Illium	4.28^{c}	5.79^{b}	6.24^{a}	5.53^{b}	6.52^{a}	3.27^{d}	2.96^{d}	4.60^{c}	0.12
caecum	5.55^{c}	6.10^{b}	6.09^{b}	5.50^{c}	6.87^{a}	2.77^{t}	3.56^{e}	5.76b^{c}	0.15
Salmonella:									
Illium	1.71^{b}	1.34^{c}	1.37^{c}	1.97^{a}	0.60^{d}	0.09^{e}	0.06^{e}	1.25^{c}	0.06
caecum	2.61^{a}	2.36^{b}	2.27^{b}	1.97^{c}	1.07^{d}	0.00^{e}	0.03^{e}	2.65^{a}	0.07
E.coli:									
Illium	7.97^{a}	6.79^{b}	6.70^{b}	5.86^{c}	4.80^{d}	4.67^{d}	3.44^{e}	7.67^{a}	0.13
caecum	7.32^{a}	6.83^{b}	6.47^{bc}	6.35^{c}	5.66^{d}	5.16^{e}	4.03^{f}	4.98^{d}	0.14

-T1=control, T2=0.5%fennel, T3=1.0%fennel, T4=0.5%thyme, T5=1.0%thyme, T6=0.5%(fennel+thyme), T7=1.0%(fennel+thyme), T8=0.05%probiotic(Livesac)

[ab,....]Means within a row with no common superscripts differ significantly (P≤0.05) based on Duncan's separation of means.

- SEM= Standard Error Mean

Table (9): The microbial content (log 10 CFU G-1) of the experimental diets.

Teatments / Parameter	Total counts	Total coliform	molds
T1 control	6.83[b]	3.52[b]	3.28[b]
T2	6.64[b]	2.37[c]	2.55[b]
T3	6.48[b]	2.09[cd]	2.17[c]
T4	6.16[b]	2.00[d]	2.25[c]
T5	6.05[b]	1.93[d]	2.04[c]
T6	4.68[c]	1.55[d]	1.50[d]
T7	4.07[c]	1.92[d]	1.07[d]
T8	8.46[a]	3.88[a]	3.92[a]
±SEM	0.26	0.11	0.16

-T1=control, T2=0.5%fennel, T3=1.0%fennel, T4=0.5%thyme, T5=1.0%thyme, T6=0.5%(fennel+thyme), T7=1.0%(fennel+thyme), T8=0.05%probiotic(Livesac)

[ab.....]Means within a column with no common superscripts differ significantly (P≤0.05) based on Duncan's separation of means.

- SEM= Standard Error Mean

Table (10): Economical efficiency of Muscovy ducks as affected by the tested feed additives

Item	T1	T2	T3	T4	T5	T6	T7	T8
Feed intake (kg/duck)	9.60	10.11	10.45	9.61	9.99	10.92	11.54	12.72
Price kg feed (PT)[1]	110.00	112.00	114.00	112.50	115.00	112.25	114.50	125.00
Total feed cost (LE)	10.56	11.32	11.91	10.81	11.49	12.26	13.21	15.90
Body weight gain (kg/duck)	2.80	2.82	3.10	2.42	2.76	3.08	2.61	2.90
Price/kg LBW(LE)[2]	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00
Total revenue (LE)	25.20	25.38	27.90	21.78	24.84	27.72	23.49	26.10
Net revenue (LE)	14.64	14.06	15.99	10.97	13.35	15.46	10.28	10.20
Economic efficiency	1.39	1.24	1.34	1.01	1.16	1.26	0.78	0.64
Relative economic efficiency %	100	89.21	96.40	72.66	71.94	90.64	56.12	46.15

1- According to the price of different ingredients available in A.R.E. at the experimental time.

2- According to the local market price at the experimental time.

PT= Egyptian piaster, LE= Egyptian pound.

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الملخص العربى

تأثير كل من بذور الشمر والزعتر ومحفز نمو تجارى كإضافات غذائية على الأداء الانتاجى والمحتوى الميكروبى للقناه الهضمية فى البط المسكوفى

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اجريت هذه الدراسة لدراسة تأثير كل من الشمر والزعتر ومحفز نمو تجارى (بروبيوتيك) على الأداء الانتاجى ومعاملات الهضم ومكونات البلازما وأجزاء الذبيحة والمحتوى الميكروبى للقناة الهضمية فى البط المسكوفى . استخدم عدد 224 كتكوت بط مسكوفى عمر يوم قسمت الى 8 مجاميع (كل مجموعة 12 ذكر و16 أنثى) كل منها فى أربع مكررات . أضيف الى العليقة الأساسية(T_1) كل من :

الشمر بمستوى 0.5% (T_2) ، 1% (T_3) والزعتر بمستوى 0.5% (T_4) ، 1% (T_5) ومخلوط من الزعتر والشمر (بنسبة 1:1) بمستوى 0.5% (T_6) ، 1% (T_7) وكذلك البروبيوتيك التجارى بمستوى 0.05% (T_8) .

احتوت العليقة الأساسية على 22 % بروتين خام و 2900 كيلو كالورى طاقة ممثلة / كجم فى فترة البادئ (من يوم – 4 أسابيع من العمر) و 19 % بروتين خام و 3000 كيلو كالورى طاقة ممثلة / كجم خلال فترة النامى والناهى (من 5 – 10 أسبوع من العمر) أوضحت النتائج أن :

- إضافة الشمر والزعتر الى عليقة الكنترول (المعاملة القياسية) حسنت معنويا كل من وزن الجسم ووزن الجسم المكتسب و معامل التحويل الغذائى وكذلك دليل الأداء الانتاجى وذلك فى الفترة الأولى من العمر (من يوم – 4 أسابيع) .

- لم يؤدى استخدام البروبيوتيك الى تحسن وزن الجسم ووزن الجسم المكتسب والغذاء المستهلك ومعامل التحويل الغذائى وكذلك دليل الأداء الانتاجى خلال نفس الفترة (من يوم – 4 أسابيع) .

فى الفترة الثانية من العمر (5 – 10 أسابيع) لم يوثر استخدام كل من الأعشاب (الشمر والزعتر) أو البروبيوتيك على الأداء الانتاجى للبط .

- إضافة الشمر والزعتر بمستوى 1% كان أفضل من 0.5% بينما استخدم المخلوط بنسبة 0.5% كان أفضل من 1% على الأداء الانتاجى للبط . تم الحصول علي أفضل أداء انتاجى للبط من إضافة الشمر بنسبة 1% (T_3) وكذلك المخلوط بنسبة 0.5% (T_6) و لم تتأثر مواصفات الذبيحة المختلفة بالمعاملات التجريبية .

- أدى استخدام الشمر والزعتر بنسبة 1% الى تسجيل أقل نسبة دهن بطن مقارنة بمستوى 0.5 % من كل منهما . بينما سجلت معاملة البروبايوتيك أعلى نسبة دهن بطن .

- لم يكن هناك اختلافات معنوية فى معاملات الهضم للمادة العضوية أو مستخلص الأثير أو المستخلص الخالى من النيتروجين فيما عدا المعاملة T_6 (المخلوط بمستوى 0.5%) و T_8 (البروبيوتيك بمستوى 0.05%) حيث سجلت النتائج قيم عالية لهذه المقاييس. سجلت المعاملات T_6 (المخلوط بمستوى 0.5%) ، T_7(المخلوط بمستوى 1%) وكذلك البروبيوتيك بمستوى 0.05% (T_8) زيادة معنوية لمعاملات هضم كلا من البروتين الخام والألياف الخام بالمقارنة بالعليقة الأساسية (T_1) .

- لم يتأثر محتوى اللحم من البروتين الخام ومستخلص الأثير بإضافة أى من الشمر أو الزعتر أو المخلوط أو البروبيوتيك .

- زاد معنويا محتوى البلازما من البروتين الكلى و الالبيومين وكذلك الجلوبيولين فى المعاملة T_3 (الشمر بمستوى 1%) وكذلك البروبيوتيك بمستوى 0.05% (T_8) بالمقارنة بالمجموعة الأساسية (T_1) .

- أدى استخدام المخلوط بمستوى 0.5% (T_6) الى تخفيض نسبة الكولسترول معنويا بالمقارنة بالمجموعة الأساسية(T_1) أو البروبيوتيك .

- انخفضت الدهون الثلاثية والكرياتينين بجميع المعاملات مقارنة بالمجموعة الأساسية و البروبيوتيك .

- جميع المعاملات خفضت إنزيمات الكبد من النوع GOT مقارنة بالمجموعة الأساسية والبروبايوتيك بينما انخفض GPT باستخدام المستوى المنخفض سواء من الشمر أو الزعتر (T_2 ،T_4) .

- انخفض معنويا عدد الميكروبات الكلية فى الأعور والمستقيم باستخدام المخلوط من الشمر والزعتر (T_6 ،T_7) بالمقارنة بباقى المعاملات وكذلك المعاملة الأساسية ، نفس النتائج تم الحصول عليها عند تقدير البروتيوليتك بكتريا ، السليوليتك بكتريا، وكذلك الليبوليتك بكتريا .

- وقد اظهرت دراسة الكفاءه الاقتصاديه ان البط المغذى على علائق تحتوى على 1 % شمر (T3) وكذلك 0.5 % مخلوط (T6) اعطت افضل كفاءه اقتصاديه مقارنة بباقى المعاملات.

و بصفة عامة يتضح أن إضافة الشمر أو الزعتر بمستوى 1% أو المخلوط منهما بمستوى 0.5 % حسن الأداء الانتاجى للبط المسكوفى فى فترة البادئ (يوم – 4 أسابيع).