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The Effect of Chamomile Flower as Feed Additive on Fat Deposition in Certain Subcutaneous Tissues, Carcass Quality and Growth Performance in Pekin Duck

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Abstract: A total number of 180 one day old Pekin ducks (Anas platyrhynchos) were classified into four equal groups of 3 replicate (15 ducklings each). The 1st group received the basal diet and served as control group (G1). The other three groups (G2-G4) received the basal diet supplemented with chamomile flowers (*Matricria chamomilla L)* as feed additive at the level of 0.25, 0.50 and 0.75%, respectively till age 12 wks. The resultsrecorded that chamomile at the 0.25, 0.50 and 0.75% levelsignificantly (P<0.05) decreased the carcass lower abdominal fat by 13, 25 and 28%, the subcutaneous fat of chest area by 8, 13 and 18%, the neck area by 11, 21 and 28% as well as the leg area by 9,16 and 25%, respectively compared to the control group. Chamomile at the 0.25, 0.50 and 0.75% level significantly (P<0.05) increased the carcass weight by 2.4, 4.2 and 5.6% and increased the gizzard weight by 14, 17 and 32%, respectively compared to the (G1). Chamomile at 0.75% level significantly (P<0.05) increased the giblet weight by 5.8% compared to the (G1). Chamomile at 0.75% level significantly (P<0.05) increased the final body weight and the average daily body weight gain by 11.6% and 12%, respectively compared to the (G1). Chamomile at 0.25, 0.50 and 0.75% level significantly (P<0.05) improved the feed conversion ratio by 12, 14 and 19%, respectively compared to the (G1). Chamomile at 0.25, 0.50 and 0.75% level significantly (P<0.05) decreased the liver transaminases, (ALT) by 16, 41 and 51% and (AST) by 10, 29 and 37%, respectively compared to the (G1). Chamomile at 0.50 and 0.75% level significantly (P<0.05) improved the globulin value by 113 and 137%, the albumin/ globulin ratio (A/G) by 51 and 52% and the total protein by 40 and 53% as well as decreased the cholesterol level by 6.9 and 20%, respectively, compared to the (G1). Chamomile at 0.75% level significantly (P<0.05) increased the albumin by 12% compared to the (G1) with no harmful effects on liver function. In conclusion, the present results clearly indicate that supplementing diet with chamomile improves carcass quality and growth performance of pekin ducks by reducing fat deposition particularly at the higher dose used of chamomile 0.75% which induces high profitability of the diet.

Key words: Pekin Ducks · *Matricria chamomilla L.* · Fat Deposition and Performance

INTRODUCTION

Animal products with a high fat content present a risk factor for many diseases. More consumers prefer a poultry carcass characterized by high meatiness and low fatness. Reducing fat content in poultry products is an important goal for the poultry industry [1]. The activity of lipase was much higher in waterfowl than in chickens [2]. In ducks, the relative high carcass fat content is determined by genetic and environmental factors including the feeding regime which affects fat deposition rate. The deposition of subcutaneous fat tissue is significant in duck [3]. The development of subcutaneous adipose tissue is achieved by both adipocyte hyperplasia and hypertrophy until the ducks are 4 wk old [4]. There is an inverse relationship between the breast-muscle yield and the abdominal fat percent in duck [5]. Our theoretical hypothesis that any compound is known to stimulate secretion of bile acids reduces the intestinal fat absorption via inhibiting pancreatic lipase [6, 7]. Chamiloflan, the effective component in *Matricaria chamomilla L*. flowers increased cholesterol bile secretion and reduced lipid content in the liver of the old rats [8].

Chamomile *Matricaria chamomilla L*. is a member of the daisy group belonging to the Asteraceae family [9]. The main constituents include several phenolic compounds, primarily the flavonoids apigenin, quercetin, patuletin, luteolin and their glucosides [10]. Flavonoids

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apigenin decreases global protein acetylation and improves several aspects of glucose and lipid homeostasis in obese mice [11]. Quercetin glycosides were shown to fully or partially prevent the detrimental metabolic effects induced by high-fat diet [12]. There were a potential of luteolin in alleviating obesity [13]. Chamomile flowers extract further showed potent prevention of associated fatty liver disease [14].

This work aimed to evaluate the effect of chamomile flowers as feed additive on carcass quality and growth performance of Pekin ducks by reducing fat deposition in 4 regions of subcutaneous tissue, including the chest area, neck area, leg area and lower abdomen area.

MATERIALS AND METHODS

Experimental Animals and Feeds: A total number of 180 growing Pekin duck (Anas platyrhynchos) at one-day-old age with an average body weight of 44.3 ±1.2 g, were divided into four equal groups, each containing 3 replicate pens with 15 birds per pen and aged to 12 wks. Chamomile *Matricaria chamomilla L*. used in this work is a grinding dried flower as feed additive. The experimental groups were classified as follow: the 1st group received basal diet and served as control (G1), while the other three groups (G2-G4) were fed on the basal diet supplemented with chamomile at the levels of 0.25, 0.50 and 0.75%, respectively during the growth period (0-12 wks of age). Basal starter (0-4wks) and finisher (5-12wks) diets were formulated to cover the nutrient requirements of ducks as a basal diet according to N.R.C. [15] and calculated analysis are shown in (Table 1). Drinking and feeders were supplied for each pen and offered *ad libitum*. Ducks of all pens were kept under the same managemental conditions and were grouped weighed. Feed consumption per pen was recorded bi-weekly during the experimental period.

Hematological Assessments: At the end of experiments, three ducks from each group were slaughtered after fasting overnight 10hr. Blood was collected in heparinized test tubes and centrifuged immediately for 10 min. at 2000 rpm and plasma obtained was rapidly frozen until biochemical analysis. Plasma samples were analyzed to detect the activities of kidney creatinine and liver aminotransferases (ALT and AST) as well as concentration of albumin, total protein, cholesterol and triglyceride. Specific diagnostic kits (Bio Meriex, France) were used according to the recommendations mentioned by Bogin and Keller [16].

Table 1: Composition and chemical analysis of the diets

Ingredient	Starter % (0-4 wks)	Finisher % (5-12 wks)
Yellow corn	63.80	72.00
Soybean meal (44%)	25.80	21.20
Broiler protein concentrates (52%)	10.00	5.00
Bone meal	0.35	1.00
Limestone	0.00	0.45
Vit. and Min.premix*	0.00	0.15
NaCl	0.00	0.15
DL.Methionine	0.05	0.05
Total	100.00	100.00
Calculated analysis		
Crude protein %	21.95	18.04
ME (Kcal/ kg)	2900	3000
Lysine	1.14	0.91
Methionine%	0.44	0.38
Calcium	0.96	0.37
Av.phosphorus	0.48	0.40

* Each 3kg of the Vit and Min premix manufactured by Agri-Vit Company, Egypt contains: Vitamin A 10 MIU, Vit D2 MIU, Vit E 10g, Vit k 2g, Tiamine 1g, Riboflavin 5g, Pyridoxine 1.5g, Niacin 30g, Vit.B12 10mg, Pantothenic acid 10g, Folic acid 1.5g, Biotin 50mg, Choline chloride 250g, Manganese 60g, Zinc 50g, Iron 30g, Copper 10g, Iodine 1g, Selenium 0.10g, Cobalt 0.10g and carrier CaCO3 to 3000g.

Carcass Traits and Fat Deposition: Three representative duck from each treatment were randomly chosen and fasted for 12 hours before slaughtering according to Blasco *et al*. [17] to determine the carcass measurements. Edible offal's include head, gizzard, liver, spleen, heart, sex organs and kidneys. These organs were removed and individually weighed and calculated as percentages of slaughter weight. Skin slice with fat in the 4 regions of subcutaneous tissue, including the chest area, neck area, leg area and lower abdomen area are considered a very good indicator of the content of fat in a whole carcass to predict the total lean meat content in ducks [18] which were removed by a knife, weighed and calculated on the basis of the carcass weight percentage according to Bochno *et al*. [19].

Statistical Analysis: Collected data were subjected to statistical analysis as two factors-factorial analysis of variance using the general linear model procedure of SPSS. [20]. Duncan's Multiple Range Test [21] was used to separate means when the dietary treatment effect was significant.

Chemical Analysis Procedures: Chemical analysis of experimental rations and feces were analyzed according to A.O.A.C. [22] methods.

Economical Evaluation: Economical efficiency of experimental diets was calculated according to the local market price of ingredients and duck live body weight as following:

Net revenue = total revenue-total feed cost.
Economical efficiency (%) = (net revenue/ total feed cost) x 100

RESULTS AND DISCUSSIONS

Fat Deposition: Supplementation of chamomile *Matricria chamomilla L* as feed additive at 0.25, 0.50 and 0.75% level significantly (P<0.05) decreased the carcass lower abdominal fat % by 13, 25 and 28%, the subcutaneous chest fat % by 7.7, 12.6 and 17.9% and the neck fat by 10.7, 20.7 and 28.0% as well as the leg fat by 8.6, 15.9 and 24.5%, respectively compared to the control group (Table 2). These results may be attributed to the ability of chamomile effective components in reducing the lipid accumulation. Fat deposition in the carcass may be attributed to a reduction of hepatic lipogenic enzyme activity [23] which induces some morphological changes with the accumulation of vesicles electrodense lipid inclusions [10]. In other words, the energy expenditure is facilitated by chamomile to prevent the accumulation of absorbed fat. Similar results showed the expenditure energy is facilitated by some spices to prevent the accumulation of the absorbed fat [24]. Chamomile extract had a potent antioxidant property in rats [25].

Carcass Characteristics: Supplementation of chamomile *Matricria chamomilla L* as feed additive at the 0.25, 0.50 and 0.75% level significantly (P<0.05) increased the carcass weight by 2.4, 4.2 and 5.6% and the gizzard weight by 14, 17 and 32%, respectively compared to the control group. Chamomile at 0.75% level significantly (P<0.05) increased the giblet weight by 5.8% compared to the control group (Table 3). These results showed that the safety edible carcass weight increased as fat deposition decreased. The main morphological change was muscle atrophy along with intramuscular lipid accumulation [26].

Supplementation of chamomile *Matricria chamomilla L* as feed additive at 0.25, 0.50 and 0.75% level significantly (P<0.05) decreased the liver weight by 4.5, 5.7 and 11.4% and the heart weight by 9.6, 14.7 and 19.9%, respectively compared to the control group (Table 3). These results may be due to the chamomile inhibitory action against the duck liver fatty acid synthesis. Similar results showed that chamomile essential oil considered a potentially useful, bioactive candidate for therapeutic applications and antioxidant activity [27]. The cretaceous plants extracts were prepared to assay their inhibitory activities against duck liver fatty acid synthesis [28].

Growth Performance: Supplementation of chamomile *Matricria chamomilla L* at 0.25, 0.50 and 0.75% level significantly (P<0.05) improved the feed conversion ratio by 12, 14 and 19%, respectively compared to the control group. Chamomile at 0.75% level significantly (P<0.05)

Table 2: Fat deposition of Pekin ducks as affected by chamomile flower at the 0.25, 0.50 and 0.75% level*

Item	Control	¼ %	½ %	¾ %	LSD
Carcass weight g	1528±12.3 c	1565±11.5 b	1592±4.4 ab	1612±4.4 a	33.3
Abdominal fat %	3.95±0.10 a	3.43±0.17 b	2.95±0.16 c	2.83±0.10 c	0.32
Skin chest %	3.64±0.05 a	3.36±0.08 b	3.18±0.07 c	2.99±0.07 d	0.66
Neck fat %	1.50±0.1 a	1.34±0.10 b	1.19±0.10 b	1.07±0.04 c	008
Leg fat %	1.51 ±0.1 a	1.38±0.08 b	1.27±0.12 c	1.14±0.12 c	0.10
Total fats %	10.6±0.12 a	9.5± 0.27 b	8.6±0.19 d	8.0± 0.15 d	0.42

* The 4 regions of subcutaneous tissue were removed, weighted and calculated on the basis of the 100 grams of carcass weight.. a, b, c, d, Means within each row in each parameter which have different superscripts differ significantly (P<0.05).

Table 3: Carcass characteristics of Pekin ducks as affected by chamomile flower at the 0.25, 0.50 and 0.75% level*

Item	Control	¼ %	½ %	¾ %	LSD
Live weight g	2183±17 a	2198±4.4 a	2212±17.6 a	2190±5.0 a	48.1
Carcass weight g	1528±12.3 c	1565±11.5 b	1592±4.4 ab	1612±4.4 a	33.3
Carcass %	70.0±0.9 b	71.2±.0.4 ab	72.0±0.07 ab	73.6±0.7 a	2.41
Liver weight g	88±.1.2 a	84±1.2 b	83±0.6 b	78±0.9 c	2.00
Heart weight g	38.7±1.5 a	35±1.5 b	33±1.2 bc	31±1.2 c	3.21
Gizzard weight g	95±2.5 c	109±5.6 b	113±7.3 b	129±4.9 a	8.21
Head weight g	186±2.7 a	191±6.7 a	175±2.6 a	193±7.3 a	20.4
Giblet weight * g	432±2.19 b	442±5.81 ab	428±11.3 b	457±6.9 a	20.9

a, b,c,d, Means within each row in each parameter which have different superscripts differ significantly (P<0.05). 1-Carcass %: Weighed and calculated on the basis of the proportion of carcass weight to 100 grams of live body weight. * Giblets include (head, gizzard, liver, spleen, heart, sex organs and kidneys). Organs %: Weighed and calculated on the basis of the proportion to 100 grams of carcass.

Table 4: Growth performance of Pekin ducks as affected by chamomile flower at the 0.25, 0.50 and 0.75% level*

Item	Control	¼ %	½ %	¾ %	LSD
Initial weight g	44.3 ±1.2 a	45.6±0.7 a	45.9±1.1 a	44.2 ±1.1 a	3.99
Final weight g	2149±93 b	2247±58 ab	2296±111 ab	2422±35 a	334
Daily body gain g	25±1.1 b	26±0.7 ab	27±1.3 ab	28±0.4 a	3.00
Total feed intake/ duck kg	8.37±0.21 a	7.78±0.24 a	7.73±0.29 a	7.82±0.21 a	0.71
Daily feed intake g	99.7±2.5 a	92.6±2.90 a	92.0±3.50 a	93.0±2.5 a	11.2
F.C.R ratio	3.68±0.24 a	3.25±0.15 b	3.16±0.12 b	3.0.±0.49 b	0.67

.a, b, Means within each row in each parameter which have different superscripts differ significantly (P<0.05).

Table 5: Hematological parameters in Pekin ducks as affected by chamomile flower at the 0.25, 0.50 and 0.75% level*

Item	Control	¼ %	½ %	¾ %	LSD
Total protein g/dl	3.37±0.09 b	4.10±0.31 ab	4.70±0.15 a	5.17±0.47 a	0.96
Albumine g/dl	2.26±0.05 b	2.18±0.10 b	2.34±0.12 ab	2.54±0.02 a	0.23
Globuline g/dl	1.11±0.14 b	1.92±0.38 ab	2.36±0.28 a	2.63±0.45 a	1.06
A/ G ratio	2.11±0.3 a	2.45±0.3 ab	1.04±0.2 b	1.03±0.2 b	0.82
AST u/l	150±1.7 a	134±3.0 b	106±2.41 c	94.0±1.1 d	3.13
ALT u/l	53.3±1.6 a	45.0±0.51 b	31.7.±2.05 c	26.3.±0.9 d	3.12
Creatinine mg/dl	2.07±0.09 a	1.97±0.43 a	1.83 ±0.26 a	1.73±0.20 a	0.88
Cholesterol mg/dl	317±3.0 a	318±1.7 a	315±1.7 a	315±2.9 a	14.0
HDL mg/dl	89±1.2 a	85±2.5 a	82±1.9 b	73±1.9 b	6.31
LDL mg/dl	332±6.0 a	351± 5.6 a	343±7.3 b	341±8.3 c	23.4
Triglycerides mg/dl	169±2.1 a	177±6.0 a	168±8.9 a	172±4.4 a	21.9

.a, b, c, d, Means within each row in each parameter which have different superscripts differ significantly (P<0.05).

Table 6: Economical evaluation of the experimental groups

Parameters	G1	G2	G3	G4
Marketing weight, Kg	2149	2247	2296	2422
Feed consumed as it is / duck, kg	8.37	7.73	7.78	7.52
Costing of one kg feed, (LE)1	3.50	3.56	3.62	3.68
Feed cost, (LE)	29.3	27.5	28.2	27.7
Management/ duck, (LE)2	4.5	4.5	4.5	4.5
Total cost, (LE)3	33.8	32.0	32.7	32.2
Total revenue, (LE)4	47.28	49.43	50.51	53.28
Net revenue	13.48	17.43	17.81	21.08
Economical efficiency5	39.9	54.5	55.7	65.5
Relative economic efficiency6	100	137	140	164
Total fats %	10.7	9.4	7.8	6.8

1 Based on prices of year 2014.

2 Include medication, vaccines, sanitation and workers.

3 Include the feed cost of experimental duck + management.

4 Body weight x price of one kg at selling which was 22LE.

5 net revenue per unit of total cost.

6 Assuming that the relative economic efficiency of control diet equal 100.

LE: Egyptians pound (local money).

increased the final body weight and average daily body weight gain by 11.6 and 12%, respectively compared to the control group (Table 4). These results may be due to the ability of chamomile flowers to improve the digestibility via reduces the upper gastrointestinal motility [29] followed in caecum by the best antimicrobial activity [30]. In other words, the chamomile essential oil α-bisabolol has been found to reduce the amount of proteolytic enzyme pepsin secreted by the stomach without any change occurring in the amount of stomach acid for sluggish digestion [31]. Similar results showed the higher inhibitory activity of *Matricaria chamomilla L* essentials oil against tested microorganism strains [32]. Chamomile extract had a potent antidiarrheal property in rats [25].

Blood Chemical Analysis: Supplementation chamomile *Matricria chamomilla L* at 0.50 and 0.75% level significantly (P<0.05) increased the total protein by 40 and 53%, respectively compared to the control group. Chamomile at 0.75% level significantly (P<0.05) increased the albumin by 12% compared to the control group (Table 5). These results may be due to the moderate antioxidant and antiplatelet activity of chamomile as shown by McKay and Blumberg [10]. Chamomile at 0.50 and 0.75% level significantly (P<0.05) increased the globulin by 113 and 137% and decreased the A/G ratio by 51 and 52%, respectively compared to the control group (Table 5). These results may be due to the immunomodulating effect of the heteropolysaccharides of *Matricaria chamomilla L*. which attributed to initiation of immuno-stimulating properties of heavy erythrocytes (Macrocytes), activization of immuno-regulation cells of peripheral blood as well as increased sensitivity of effect or cells to helper signals [33].

Supplementation chamomile *Matricria chamomilla L* at 0.25, 0.50 and 0.75% level significantly (P<0.05) decreased the liver enzymes ALT by 16, 41 and 51% and AST by 10, 29 and 37%, respectively compared to the control group (Table 5). These results may be due to the chamomile flowers further potent prevention of fatty liver. In other words, flavonoids can elevate neutral and acid SMases activities and ceramide mass in ducks after the 4 wks age as shown in old rats by Babenko and Shakhova [34].

Supplementation chamomile *Matricria chamomilla L* at all levels used slightly and insignificantly improved the cholesterol, the high density lipoprotein (HDL), low density lipoprotein (LDL) and triglyceride values in dietary Pekin ducks (Table 5). These results may be due to the ability of ducks to transport the high cholesterol. Similar results showed the exogenous cholesterol consumed by Pekin ducks was carried and transported by HDL confirming the differences of serum cholesterol and lipoproteins in animals susceptible and non susceptible to atherosclerosis [35].

Economical Evaluation: The economical efficiency of dietary treatments is presented in Table 6. The profitability of using chamomile flowers as feed additives depends upon the price of tested diets and the growth performance of ducks fed these diets. Supplementation chamomile *Matricria chamomilla L* as feed additive at 0.25, 0.50 and 0.75% level significantly (P<0.05) decreased the total fat carcass deposition by 10.7, 20.7 and 28.0%, as well as the assuming relative economic efficiency of control diet increased by 37, 40 and 64%, respectively compared to the control group (Table 6). These results confirm that not only the carcass quality but also the profitability improved through the inverse relationship between the fat deposition percent and the carcass muscle yield in Pekin ducks.

CONCLUSION

It could be concluded that supplementing of chamomile *Matricria chamomilla L* as feed additive at the 0.75% level improved the morphological characteristics of fat deposition in the chest area, neck area, leg area and lower abdomen area and improved the growth performance as well as profitability in growing Pekin ducks.

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