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Effects of feed supplementation of *Thymus vulgaris* (Lamiaceae) powder on growth performance, carcass characteristics and blood profiles of maturing Cameroonian local kabir rooster

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Key words: *Thymus vulgaris*, Feed supplementation, Growth parameters, Blood

Abstract

The present study was conducted to evaluate the effects of dietary supplementation of *Thymus vulgaris* on growth performance, morphometric, carcass and blood parameters in local Kabir rooster. Chicks were randomly assigned to one of the four dietary treatments (10 chicks per treatment). One group (T_0) received a basal diet, two others received a basal diet supplemented with 0.5% (T_5) and 1% (T_{10}) of thyme while the fourth (T_{Oxy}) received Oxykel 80 WP. Feed intake was calculated, body weight and morphometric traits were recorded. Haematological analyses and the carcass parameters were evaluated. Feed supplemented gradual level of thyme resulted in a significant improvement in the overall performance parameters compared to the control. Roosters fed 1% thyme displayed a better feed conversion ratio than other ($P<0.05$). They showed highest body weight gain, carcass weight and heart relative weight compared to the values obtained in birds fed basal diet. A significant decrease of spleen and gizzard relative weights was recorded in chicken fed on thyme. Except the wing length, the chest circumference and thigh diameter, dietary treatment had significant effect on the body measurement characteristics ($P<0.05$). But the gain values of neck length, chest circumference and tarsus length were significantly increased in chicken fed thyme supplemented diets ($P<0.05$). Roosters fed on thyme also had higher ($P<0.05$) red and white blood cells, haematocrit and mean corpuscular haemoglobin concentration. It could be concluded that thyme could be included in local chicken diets to promote their growth performance, improve their carcass characteristics and health status.

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Introduction

The desire to satisfy the high demand of broiler, due to the exponential increase of the demography, has pushed farmers to refer on antibiotics to enhance their productivities. Antibiotics have been widely used as growth promoters (Abdel-Ghaney *et al.*, 2017) and as diseases controller in poultry (Castanon, 2007; Zulkifli *et al.*, 2012). Their advantages in poultry production are well established (Miles *et al.*, 2006; Castanon, 2007). However, antibiotics have been reported to be an important risk factor of toxicity and pathogen resistance in animals (Schwarz *et al.*, 2001). Moreover, antibiotics can be transferred to consumers through animal products such as egg, meat and milk (Schwarz *et al.*, 2001; Darwish *et al.*, 2013). Antibiotic residues can transfer bacteria resistant to humans, and have been related to numerous health concerns such as hepatotoxicity, allergy and reproductive disorders (Nisha, 2008). Because of their adverse effects, most antibiotics are considered as public health issue and are banned in poultry production (An *et al.*, 2015; Abdel-Ghaney *et al.*, 2017). Antibiotics alternative such as herbal extracts or essential oil have then been explored by scientists.

Several plants, plant extracts or herbal essential oils have been given or incorporated in poultry feed as growth promoters (Lee *et al.*, 2005; Javed *et al.*, 2009; Tellez et Latorre, 2017). In fact, plants extracts or essential oil derived from plants improve the health status of animals through their antifungal, antiviral, anti-coccidian or antibacterial properties and antioxidant activities (Gumus *et al.*, 2017). Their benefits in improving growth performances are well documented (Zulkifli *et al.*, 2012; Pourmahmoud *et al.*, 2013; Abdel-Ghaney *et al.*, 2017; Attia *et al.*, 2017). Plant extracts enhance digestibility by stimulating endogenous enzyme activity and facilitating nitrogen absorption (Abdel-Ghaney *et al.*, 2017; Gumus *et al.*, 2017). *Thymus vulgaris* is one of herbal which have been reported to have beneficial effects in poultry nutrition (Khan *et al.*, 2012; Toukala *et al.*, 2020). It incorporation in layer diets at 0.1 and 0.5% improved feed conversion and egg production (Bölükbaşi et Erhan, 2007). On broilers, several studies showed significant effects of *Thymus vulgaris* powder on carcass traits and growth performances (Navid et Mahmoud, 2011; Ragaa *et al.*, 2016).

At contrary, other authors reported no influence of dry *Thymus vulgaris* leaves on broilers performance (Demir *et al.*, 2008; Ocak *et al.*, 2008; Ayoola *et al.*, 2014). Pourmahmoud *et al.* (2013) also showed that *Thymus vulgaris* extracts (0.2-0.4-0.6%) had no effect on performance of broilers. Recent studies reported that feed supplemented with *Thymus vulgaris* essential oil resulted in significantly higher growth performance and profit in broiler production (Attia *et al.*, 2017; Wade *et al.*, 2018). The effects of *Thymus vulgaris* leaves powder supplementation on growth performance are controversial. The present study was then conducted to evaluate the effects of dietary supplementation of whole *Thymus vulgaris* (roots, stem and leaves) on growth performance, morphometric parameters, carcass characteristics and blood parameters in local Kabir rooster.

Materials and methods

Study site

This research was carried out at the Buea's Green Gold Agri Venture Poultry Research, South-West Region of Cameroon (4°12,773' to 4°4,25'N and 9°19,425' to 9°9,20'E) and at the Life Sciences Laboratory of the Faculty of Science, University of Buea as well as at the Laboratory of Animal Physiology and Health, FASA, University of Dschang.

Preparation of plant's powder

The whole *Thymus vulgaris* plant used was purchased from the local market. Dried samples (roots, stem and leaves) were grinded to powder, conserved into separate and labelled plastic bags, sealed and stored in a cool dry place until use.

Experimental Animals

Local Kabir chicks were provided by the Association of Farmers and Breeders of Kevin Foto Dschang (AEKDS), Cameroon. Chicks were transferred to study site after sexing at 6 weeks old. They were reared in 1m² wood cages (density of 5 animals/m²) equipped with drinkers and feeders. Cages were cleaned with water and disinfected with virunet® solution two weeks before their arrival. Chicks were

identified by tags and allowed for acclimatization for a week, then placed in the cages.

Diets and experimental design

Chicks were receiving water and feed *ad libitum*. They were fed on basal diet (Table 1) according to their stage of development: growth diet from 8 to 21 weeks then reproductive diet from 22 weeks and above (Tadondjou *et al.*, 2014). Four pens of chicks (5 birds/pen) repeated once, were randomly assigned to one of the four dietary treatments:

T_0: Basal diet (Control)

T_5: Basal diet + 0.5% *T. vulgaris* powder

T_{10}: Basal diet+1.0% *T. vulgaris* powder

T_{Oxy}: Basal diet + commercial antibiotic (Oxykel 80WP)

The antibiotic was added to water following manufacturer's instruction (0.5g/L of water for 3 continuous days weekly) while the addition of plant powders to basal diet was done daily (Ndzi *et al.*, 2016).

Table 1. Ingredient and chemical composition of rooster growth and reproductive diets.

Feed ingredient (kg)	Growth	Reproduction
Maize	49.0	52.0
Wheat bran	22.0	25.5
Cotton seed cake	8.0	3.0
Soybean cake	7.0	3.0
Fish meal	6.5	3.0
Bone meal	1.5	7.0
Shellfish powder	5.0	1.0
Premix 5% (*)	1.0	5.5(1)
Total	100.0	100.0
Crude protein (%)	20.70	15.38
ME (kcal/kg)	3013.51	2723.78
Calcium (%)	1.51	3.45
Phosphor (%)	0.73	0.69
Lysine (%)	1.10	0.72
Met (%)	0.40	0.29

*Premix 5%: crude protein = 40%; Metabolizable energy = 2078 kcal/kg; Calcium = 8%; Phosphor = 2.05%; Lysine = 3.30%; Met (Methionine) = 2.40%; ME = Metabolizable energy.

Feed intake and body weight

Feed intake was calculated by subtract the leftover feed weight from the weight of feed initially provided. The individual body weight was recorded weekly before feeding. Cumulated feed intake and body weight gain were calculated at the end of the experiment and permitted to evaluate the consumption index (Saki *et al.*, 2014).

Morphometric parameters

Height (8) characteristics of zoometric variables: body length, head length, neck length, wing length, chest circumference, thigh diameter, and tarsus length and diameter were recorded (Francesch *et al.*, 2011). The length gains or diameter gains were obtained by the different between measurement taken at the end and those recorded at the beginning of the experiment.

Carcass characteristics

At the end of the experiment (28 weeks old), three birds from pen replicate were randomly removed, weighed to obtain the live weight, then slaughtered by decapitation. The head and viscera were removed after plucking feathers. Carcass and inner organs (heart, liver, gizzard, lungs, kidney, pancreas and spleen) were weighted and expressed as percentage live body weight.

Hematological profile

The blood was collected from slaughtered birds by using anticoagulant in test tube for hematological analysis. Haematological analysis was performed using an automatic haematological analyser (Bechman Coulter, Coulter A^c. T BR-13692A).

The parameters included: red blood cell (RBC) count, leukocyte (WBC) count, Lymphocytes (%), haemoglobin, haematocrit and platelet count, mean corpuscular volume (MCV), mean corpuscular haemoglobin (MCH) and mean corpuscular haemoglobin concentration (MCHC) (Nghonjuyi *et al.*, 2015).

Statistical analyses

Data collected were subjected to analysis of variance (ANOVA) at $P<0.05$. When differences were significant, Duncan multiple range tests were used to separate means. All statistical analyses were performed using the Statistical Package for Social Sciences software (SPSS, IBM version 21.0).

Results

Effects of feed supplementation of Thymus vulgaris powder on food consumption

The effects of feed supplementation at different level of *Thymus vulgaris* on feed consumption are presented on Fig. 1.

Irrespective of the treatment, feed consumption increased throughout experimental period; and there was no difference (P> 0.05) between treatments for the same week.

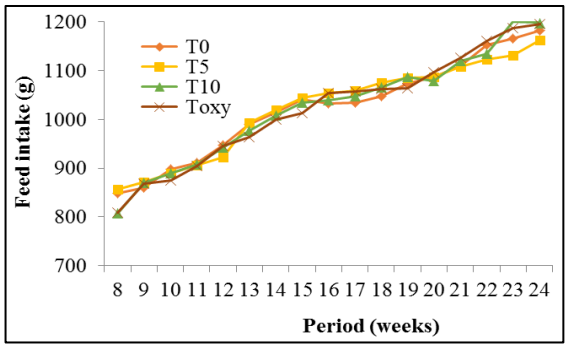

Fig. 1. Effects of *Thymus vulgaris* powder on the weekly diet intake T_0, T_5, T_{10} and T_{oxy} are groups which received feed supplementation respectively with *Thymus vulgaris* 0, 0.5 and 1% or Oxykel 0.5g/L.

Effects of feed supplementation of Thymus vulgaris powder on food body weight, body weight gain and consumption index

The effects of *Thymus vulgaris* on the evolution of body weight are illustrated in Fig. 2. Independently to the treatment, body weight showed the same evolution. It increased rapidly from week 8 to week 18. From the 18th week, growth became slow. Considering treatments, body weight of birds feed on basal diet (T_0) was the lowest during the experiment (P<0.05).

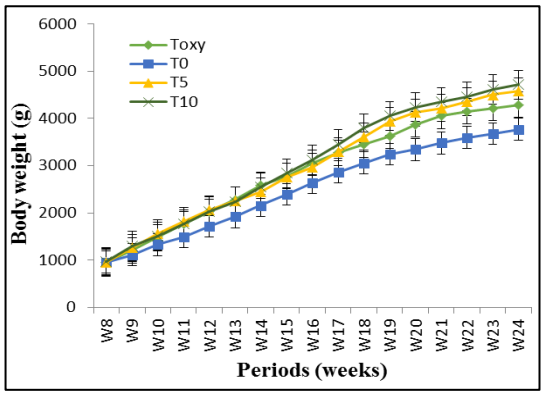

Fig. 2. Effect of *Thymus vulgaris* powder on body weight evolution of Kabir roosters.

Obtained data revealed that the values of body weight gain were significantly different between treatments. The highest weight gains were attained in birds fed on diets supplemented with thyme (T_5) and (T_{10}), while the lowest was recorded in birds fed on basal diet (T_0) (Fig. 3).

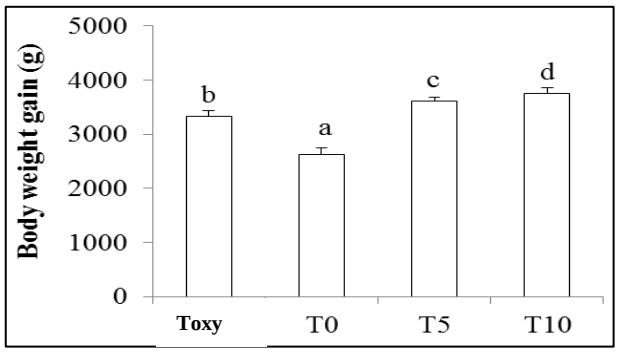

Fig. 3. Effects of feed supplemented with *Thymus vulgaris* powder on Kabir rooster body weight gain. [a,b] Means with different letters are significantly different (P<0.05). T_0, T_5, T_{10} and T_{oxy} are groups which received feed supplementation respectively with *Thymus vulgaris* 0, 0.5 and 1% or Oxykel 0.5g/L.

Consumption index

The effect of feed supplemented with *Thymus vulgaris* on the consumption index as shown on Fig. 4 below revealed that consumption index varied significantly according to treatment. Rooster receiving feed supplemented with 1% of *Thyme vulgaris* (T_{10}) had the lowest value (P<0.05), while bird in treatment T_0 showed a significant increase.

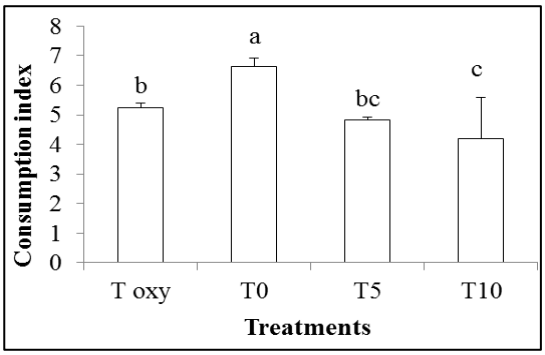

Fig. 4. Effects of feed supplemented with *Thymus vulgaris* powder on the feed consumption index of Kabir roosters. T_0, T_5, T_{10} and T_{oxy} are groups which received feed supplementation respectively with *Thymus vulgaris* 0, 0.5 and 1.0% or Oxykel 0.5g/L. [a,b] Means in the same line with different letters are significantly different (P<0.05).

Morphometric parameters

Except the wing length, the chest circumference and thigh diameter, dietary treatment had significant effect on the body measurement characteristics of the matured Kabir roosters.

The greatest performance was recorded in birds receiving feed supplemented with 1% of *Thyme vulgaris* (T_{10}) ($p<0.05$). Furthermore, the gain values of neck length, chest circumference and tarsus length significantly ($P<0.05$) increased in chicken fed thyme supplemented diets (Table 2).

Table 2. Effects of thyme supplemented feed on some morphometric measurement of Kabir rooster.

Zoometric measurement (mm)		Treatments				P
		T_{oxy} (n=10)	T_0 (n=10)	T_5 (n=10)	T_{10}(n=10)	
HL	I	75.54±4.36^{a}	74.11±5.96^{a}	74.20 ±5.47^{a}	75.19±4.61^{a}	0.90
	F	92.97±4.59^{ab}	90.45±4.67^{b}	93.32±1.95^{ab}	95.23±2.53^{a}	0.04
	G	17.44±5.00^{a}	16.35±5.11^{a}	19.13±24.93^{a}	20.04 ±4.76^{a}	0.35
NL	I	114.78±7.14^{a}	112.75±13.92^{a}	99.91±13.10^{b}	94.18±11.05^{b}	0.00
	F	168.50±7.47^{b}	162.50±8.58^{b}	181.00±11.00^{a}	178.50±7.38^{a}	0.00
	G	53.72±9.42^{b}	49.75±14.64^{b}	81.09±14.47^{a}	84.32±15.26^{a}	0.00
WL	I	209.00±13.70^{a}	213.00±20.84^{a}	201.50±18.72^{a}	195.50±33.87^{a}	0.34
	F	265.30±6.13^{a}	259.25±21.60^{a}	267.00±13.22^{a}	263.00±6.32^{a}	0.60
	G	56.30±16.37^{a}	46.25±18.68^{a}	65.50±25.84^{a}	67.50±30.48^{a}	0.18
BL	I	202.25±21.03^{a}	201.75±16.16^{a}	206.75±18.78^{a}	190.53±32.90^{a}	0.46
	F	272.25±6..71^{b}	268.75±7.75^{b}	281.80±7.47^{b}	267.50±14.39^{a}	0..01
	G	70.00±21.89^{a}	67.00±15.36^{a}	75.05±21.38^{a}	76.97±38.75^{a}	0.82
CC	I	195.86±16.30^{a}	199.72±23.66^{a}	189.75±15.47^{ab}	157.13±64.29^{b}	0.04
	F	363.80±17.16^{a}	361.50±14.92^{a}	362.75±11.33^{a}	367.00±14.33^{a}	0.85
	G	167.94±24.71^{b}	161.78±22.58^{b}	173.00±16.61^{ab}	209.87±72.40^{a}	0.04
TD	I	23.44±4.99^{a}	26.34±6.84^{a}	26.55±6.18^{a}	26.23±4.78^{a}	0.58
	F	45.92±7.02^{a}	45.61±4.8^{a}	48.65±2.59^{a}	48.72±3.21^{a}	0.30
	G	22.49±6.10^{a}	19.26±6.63^{a}	22.09±5.89^{a}	22.49±6.25^{a}	0.60
TsD	I	12.89±1.56^{a}	12.99±1.38^{a}	13.79±1.61^{a}	14.17±5.65^{a}	0.75
	F	18.80±1.68^{b}	19.87±0.67^{ab}	19.80±0.78^{ab}	20.19±1.14^{a}	0.04
	G	12.89±1.56^{a}	12.99±1.38^{a}	13.79±1.61^{a}	14.17±5.65^{a}	0.75
TsL	I	74.72±7.95^{a}	72.63±10.86^{a}	75.76±8.72^{a}	71.16±6.03^{a}	0.63
	F	118.81±7.05^{cb}	118.07±3.46^{c}	124.11±7.51^{ab}	128.62±5.73^{a}	0.00
	G	44.09±11.08^{b}	45.44±11.99^{b}	48.35±10.27^{ab}	57.46±7.68^{a}	0.03

$^{(a,b)}$Means with the same letters within the lines are not significantly different ($P>0.05$). T_0, T_5, T_{10} and $T_{oxy}$are groups which received feed supplementation respectively with *Thymus vulgaris* 0, 0.5 and 1% or Oxykel 0.5g/L; HN: head length; NL: neck length; WL: wing length; BL: body length; CC: chest circumference; TD: Thigh diameter; TsD: tarsus diameter; TsL: tarsus length; n: number of roosters; I: initial; F: final; G: gain.

Table 3. Carcass and relative organ weights (%) of Kabir roosters fed on diets supplemented with gradual level of *Thymus vulgaris* or commercial antibiotic.

Variable	Traitements				p
	T_{oxy} (n=6)	T_0 (n=6)	T_5 (n=6)	T_{10} (n=6)	
Live body weight (g)	4284.67±127.75^{b}	3633.50±91.43^{c}	4315.67±83.21^{b}	4707.33±88.61^{a}	0.00
Carcass weight (g)	3416.50±98.47^{b}	2735.17±300.67^{c}	3508.00±48.48^{b}	3990.83±128.64^{a}	0.00
Heart weight (%LBW)	0.35±0.04^{b}	0.40±0.04^{b}	0.38±0.09^{b}	0.49±0.04^{a}	0.00
Liver weight (%LBW)	0.91±0.12^{a}	0.94±0.06^{a}	0.96±0.12^{a}	0.89±0.13^{a}	0.71
Gizzard weight (%LBW)	1.18±0.03^{b}	1.40±0.27^{a}	1.19±0.06^{b}	1.17±0.04^{b}	0.04
Kidneys weight (%LBW)	0.14±0.07^{a}	0.17±0.01^{a}	0.15±0.07^{a}	0.16±0.05^{a}	0.90
Pancreas weight (%LBW)	0.10±0.02^{a}	0.10±0.01^{a}	0.10±0.00^{a}	0.10±0.01^{a}	0.89
Lungs weight (%LW)	0.34±0.09^{a}	0.39±0.04^{a}	0.37±0.04^{a}	0.36±0.09^{a}	0.64
Spleen weight (%LW)	0.11±0.02^{a}	0.11±0.05^{a}	0.08±0.01^{ab}	0.07±0.01^{b}	0.04

[a,b]Means with the same letters within the lines are not significantly different (P>0.05). T_0, T_5, T_{10} and T_{oxy} are groups which received feed supplementation respectively with *Thymus vulgaris* 0, 0.5 and 1% or Oxykel 0.5g/L; LBW: live body weight.

Table 4. Effects of *Thymus vulgaris* incorporation in diet on haematological parameters.

Blood parameters	Treatments				P
	T_{oxy}	T_0	T_5	T_{10}	
RBC ($\times 10^{12}$ µL-1)	2.78±0.09[a]	2.39±0.22[b]	2.32±0.21[b]	2.56±0.29[ab]	0.01
WBC ($\times 10^9$/µL)	63.63±0.72[a]	60.94±0.23[b]	63.91±0.49[a]	64.38±0.22[a]	0.01
Lymphocytes (%)	28.12±0.69[a]	28.93±0.28[a]	28.68±0.33[a]	28.53±0.69[a]	0.39
Haemoglobin (g/dL)	12.77±0.78[b]	13.44±0.13[ab]	13.65±0.64[a]	13.37±0.56[ab]	0.04
Haematocrit (%)	33.72±0.05[b]	33.54±0.21[b]	34.71±0.88[b]	38.19±0.74[a]	0.01
MCV ($\times 10^6$ µL-1)	125.33±0.93[a]	125.70±0.34[a]	125.93±0.74[a]	125.80±0.60[a]	0.81
MCH (pg)	16.01±0.17[a]	15.88±0.14[a]	15.95±0.23[a]	16.04±0.19[a]	0.77
MCHC (g/dL)	28.10±0.12[a]	28.01±0.17[b]	28.86±0.25[a]	28.93±0.21[a]	0.01
Platelets ($\times 10^3$ µL-1)	6.23±0.07[c]	6.67±0.06[ba]	6.59±0.14[b]	6.75±0.08[a]	0.01

[a,b]Means with the same letters within the lines are not significantly different (P>0.05). T_0, T_5, T_{10} and T_{Oxy} are groups which received feed supplementation respectively with *Thymus vulgaris* 0, 0.5 and 1% or Oxykel 0.5g/L; RBC: red blood cells; WBC: white blood cells;mcV: mean corpuscular volume;mcH: mean corpuscular haemoglobin;mcHC: mean corpuscular haemoglobin concentration; pg: pictogram; g: gram; µL= microliter.

Carcass characteristics

Feed supplemented with *Thymus vulgaris* significantly (P<0.05) increased live body weight, carcass weight and heart weight as compared to the values obtained in birds fed on basal diet (T_0). Meanwhile, gizzard weight and spleen weight were significantly (P<0.05) lower in rooster fed on diet supplemented with thyme when compared to values recorded in birds fed on basal diet (Table 3). No significant differences were observed in liver, kidneys pancreas and lungs relative weights between treatments (p>0.05).

Haematological profile

Among haematological parameters studied, only haematocrit (38.19±0.74%), white (64.38±0.22 10^9/µL) and red (2.56±0.29 10^{12}µL-1) blood cells and Mean corpuscular haemoglobin concentration (28.93±0.21 g/dL) were significantly increased (P < 0.05) in the thyme supplemented dietary groups as compared with control (Table 4).

Discussion

This study was conducted to assess the benefits of *Thymus vulgaris* powder used as feed additives on growth performances, carcass characteristics and body measurement in maturing local Kabir rooster in lieu of commercial antibiotics. Obtained results showed that treatments did not significantly affect feed consumption. Feed supplemented with 0.5% or 1.0% *Thymus vulgaris* powder did not affect Kabir roster feed taste.

This corroborate with the results of Ciftci *et al.* (2009) who showed that lower concentration of thyme oil in diets did not affect feed consumption in boiler chickens. This may be due to its low concentration Zaoui *et al.* (2002). In fact, in higher concentration, some *Thymus vulgaris* ingredients like saponin, alkaloids and volatile oils, can negatively affect the feed taste (Ciftci *et al.*, 2009). The increase of feed consumption within the same treatment during the experiment (from the beginning to the end), would be linked to the nutritional needs which increase with age and growth.

Kabir roosters fed on *Thymus vulgaris* supplemented diet (T_{10} and T_5) grew faster than birds fed on control diets (T_0) and those treated with oxykel (T_{Oxy}). It was the same observation with the total body weight gain where, bird fed on 1.0% of *Thyme vulgaris* (T_{10}) showed the highest body weight gain, and had the lowest average of the feed consumption index. These results indicate that *Thymus vulgaris* may have growth promoting properties as reported by several authors (Cross *et al.*, 2007; Ciftci *et al.*, 2009; Toghyani *et al.*, 2010; Al-Mashhadani *et al.*, 2011; Ragaa *et al.*, 2016). This may be at least due to its ability in combating intestine bacteria diseases in

poultry (Acamovic et Brooker, 2005). Furthermore, *Thymus vulgaris* benefit effects on growth may result to its potentiality to stimulate the secretion of digestive enzymes and thus enhance digestibility (Cross *et al.*, 2007; Abdel-Ghaney *et al.*, 2017; Gumus *et al.*, 2017).

These results are opposite to findings of other authors who reported no influence of *Thymus vulgaris* on broiler performance. The difference may be attributed to the percentage of incorporation or the part of the plant used. For instance, Ocak *et al.* (2008) or Ayoola *et al.* (2014) used dry thyme leaves while we used the whole plant (roots, stem and leaves). The addition of *Thymus vulgaris* might then improve nutrients availability and nutrients uptake which would make a diet containing *Thymus vulgaris* more efficient (Langhout, 2000; Mansoub, 2011).

In general, morphometric parameters studied increased with age. There was a large variation in body measurement of Kabir rooster depending on treatments. Birds receiving 1% of *Thymus vulgaris* showed the best increasing, especially in neck length, chest circumference and tarsus length. This result shows that Kabir roster growth is more related to the development of chest circumference, neck length and tarsus length. This may be due to the benefit effects of the main active component of *Thymus vulgaris*: thymol and carvacrol (Ciftci *et al.*, 2009; Manafi *et al.*, 2014). Dietary incorporation of *Thymus vulgaris* powder improved the carcass weight. This result is in agreement with several authors who reported significant effect of *Thymus vulgaris* on growth performance and carcass trait (Navid et Mahmoud, 2011; Ragaa *et al.*, 2016). This can be explained at least partly by an improvement of muscle development. In fact, our results showed better development of chest muscle in birds fed on *Thymus vulgaris* incorporated diets.

Results revealed that, the percentage of heart weight increased significantly in birds fed on 1% of *Thymus vulgaris* powder, which presented the highest carcass weight and muscle development. However, it is important to note that all those values were within the range value of heart relative weight in chicken (Sturkie *et al.*, 1986; Pourmahmoud *et al.*, 2013). The same tendency was observed by feeding broilers with 100 ppm and 200 ppm or 2% of *Thymus vulgaris* oil (Al-Kassie, 2009; El-Ghousein et al-Beitawi, 2009). *Thymus vulgaris* effect on heart development may be explained by it general effect on body development. In fact, faster growing chicken as broiler has higher heart relative weight (around 0.50) than local chicken (0.44). The gizzard relative weight was significantly higher in birds fed on control diet. This may be explained by the effect of *Thymus vulgaris* in gizzard digestion. It is well documented that gizzard development is related to the size of the food particles (Belabbas, 2007). However, gizzard is also where proteinolysis and even lipogenesis start (Sturkie *et al.*, 1986). Thus the digestive properties of *Thymus vulgaris* would have facilitated the function of gizzards providing less effort for its digestive functions. Compared with the control group, birds fed on diet supplemented with gradual level of plant powder presented a significant decrease of spleen's relative weight. *Thymus vulgaris,* by its antibacterial, antifungal, anti-coccidian antiviral and antioxidants properties (Lee *et al.*, 2007; Amarti *et al.*, 2011; Bakkali Yakhlef *et al.*, 2011; Katooli *et al.*, 2012; Abou-Elkhair *et al.*, 2014) would have protected the spleen from stress. Those properties of *Thymus vulgaris* can also explain the good health status of chicken fed on this plant powder supplemented diets which showed higher values of hematocrit, white blood cell and Mean corpuscular hemoglobin concentration. In fact, it has been reported that *Thymus vulgaris* stimulate the immune system of chicken and increase the production of globulin (Abdel-Ghaney *et al.*, 2017; Attia *et al.*, 2017; Luaibi *et al.*, 2017). The benefit effect of *Thymus vulgaris* on hematocrit and Mean corpuscular hemoglobin concentration may be related to its anti-oxidant activities which protect red blood cells from oxidative decomposition (Luaibi *et al.*, 2017).

Conclusion

Thyme powder incorporation in feed at 1% improves growth performances, carcass traits and health status of local Kabir chicken. *Thymus vulgaris* powder could be used as growth promoter in poultry.

References

Abdel-Ghaney DM, Ali H, Sadek KM, El-Sayed YS, Abdel-Latif MA. 2017. Impact of Dietary Thyme (*Thymus vulgaris*) on Broiler Chickens Concerning Immunity, Antioxidant Status, and Performance. Alexandria Journal of Veterinary Sciences **55(1),** 169-179.

Abou-Elkhair R, Gaafar KM, Elbahy N, Helal MA, Mahboub HD, Sameh G. 2014. Bioactive effect of dietary supplementation with essential oils blend of oregano, thyme and garlic oils on performance of broilers infected with Eimeria species. Global Veterinaria **13(6),** 977-985.

Acamovic T, Brooker J. 2005. Biochemistry of plant secondary metabolites and their effects in animals. Proceedings of the Nutrition Society **64(3),** 403-412.

Al-Kassie GA. 2009. Influence of two plant extracts derived from thyme and cinnamon on broiler performance. Pakistan Veterinary Journal ***29*(4),** 169-173.

Al-Mashhadani EH, Farah K, Al-Jaff Y. 2011. Effect of anise, thyme essential oils and their mixture (EOM) on broiler performance and some physiological traits. Egyptian Poult Sci **31(2),** 481-489.

Amarti F, Satrani B, Ghanmi M, Aafi A, Farah A, Aarab L, El Ajjouri M, Guedira A, Chaouch A. 2011. Activité antioxydante et composition chimique des huiles essentielles de quatre espèces de thym du Maroc. Acta botanica gallica **158(4),** 513-523.

An B, Kim J, Oh S, Kang C, Cho S, Kim S. 2015. Effects of onion extracts on growth performance, carcass characteristics and blood profiles of white mini broilers. Asian-Australasian Journal of Animal Sciences **28(2),** 247.

Attia YA, Bakhashwain AA, Bertu NK. 2017. Thyme oil (*Thyme vulgaris* L.) as a natural growth promoter for broiler chickens reared under hot climate. Italian Journal of Animal Science **16(2),** 275-282.

Ayoola M, Adedeji O, Oladepo A. 2014. Effects of dietary thyme leaf on broiler growth performances, carcass characteristics and cooking yield of the meat. Glob J Sci Res **12,** 47-50.

Bakkali Yakhlef SE, Abbas Y, Prin Y, Abourouh M, Perrineau M-M, Duponnois R. 2011. Effective arbuscular mycorrhizal fungi in the roots of Tetraclinis articulata and Lavandula multifida in Moroccan Tetraclinis woodlands. Mycology **2(2),** 79-86.

Belabbas H. 2007. Dynamique de croissance des organes chez le poulet de chair. Mémoire de Magister, Université de Batna, Algérie.

Bölükbaşi ŞC, Erhan MK. 2007. Effect of Dietary Thyme (*Thymus vulgaris*) on Laying Hens Performance and *Escherichia coli* (*E. coli*) Concentration in Feces. International Journal of Natural & Engineering Sciences **1(2)**.

Castanon J. 2007. History of the use of antibiotic as growth promoters in European poultry feeds. Poultry Science **86(11),** 2466-2471.

Ciftci M, Guler T, Simsek UG, Ertas ON, Dalkilic B, Bicer Z. 2009. The effect of Thymus vulgaris L. oil as growth promoter in broilers. Indian Veterinary Journal, **86(9),** 930-932.

Cross D, mcDevitt R, 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 **48(4),** 496-506.

Darwish WS, Eldaly EA, El-Abbasy MT, Ikenaka Y, Nakayama S, Ishizuka M. 2013. Antibiotic residues in food: the African scenario. Japanese Journal of Veterinary Research **61,** S13-S22.

Demir E, Kilinc K, Yildirim Y, Dincer F, Eseceli H. 2008. Comparative effects of mint, sage, thyme and flavomycin in wheat-based broiler diets. Archiva Zootechnica, **11(3),** 54-63.

El-Ghousein SS, Al-Beitawi NA. 2009. The effect of feeding of crushed thyme (*Thymus valgaris* L) on growth, blood constituents, gastrointestinal tract and carcass characteristics of broiler chickens. The Journal of Poultry Science **46(2),** 100-104.

Francesch A, Villalba I, Cartana M. 2011. Methodology for morphological characterization of chicken and its application to compare Penedesenca and Empordanesa breeds. Animal Genetic Resources/Resources génétiques animales/Recursos Genéticos Animales **48,** 79-84.

Gumus R, Ercan N, Imik H. 2017. The effect of thyme essential oil (*Thymus vulgaris*) added to quail diets on performance, some blood parameters, and the antioxidative metabolism of the serum and liver tissues. Brazilian Journal of Poultry Science **19(2),** 297-304.

Javed M, Durrani F-R, Hafeez A, Khan RU, Ahmad I. 2009. Effect of aqueous extract of plant mixture on carcass quality of broiler chicks. ARPN Journal of Agricultural and Biological Science **4(1),** 37-40.

Katooli N, Maghsodlo R, Honari H, Razavi S. 2012. Fungistatic activity of essential oil of thyme and eucalyptus against of postharvest and soilborne plant pathogenic fungi. Global Journal of Medicinal Plant Research **1(1),** 1-4.

Khan R, Naz S, Nikousefat Z, Tufarelli V, Laudadio V. 2012. Thymus vulgaris: alternative to antibiotics in poultry feed. World's Poultry Science Journal **68(3),** 401-408.

Langhout P. 2000. New additives for broiler chickens. World poultry **16(3),** 22-27.

Lee K-J, Dabrowski K, Sandoval M, Miller MJ. 2005. Activity-guided fractionation of phytochemicals of maca meal, their antioxidant activities and effects on growth, feed utilization, and survival in rainbow trout (*Oncorhynchus mykiss*) juveniles. Aquaculture **244(1-4),** 293-301.

Lee S-O, Choi G-J, Jang K-S, Lim H-K, Cho K-Y, Kim J-C. 2007. Antifungal activity of five plant essential oils as fumigant against postharvest and soilborne plant pathogenic fungi. The Plant Pathology Journal **23(2),** 97-102.

Luaibi NM, Jasim MG, Mousa AH. 2017. A Study Medicinal and Nutritional Effects of Thyme on Hematological Changes in Male Albino Rats. Iraqi Journal of Science, **58(3A),** 1177-1188.

Manafi M, Hedayati M, Yari M. 2014. Aflatoxicosis and herbal detoxification: the effectiveness of thyme essence on performance parameters and antibody titers of commercial broilers fed aflatoxin B1. Research in Zoology **4(2),** 43-50.

Mansoub NH. 2011. Assessment on effect of thyme on egg quality and blood parameters of laying hens. Annals of Biological Research **2(4),** 417-422.

Miles R, Butcher G, Henry P, Littell R. 2006. Effect of antibiotic growth promoters on broiler performance, intestinal growth parameters, and quantitative morphology. Poultry Science **85(3),** 476-485.

Navid H, Mahmoud P. 2011. Comparative Effect of using Neem, Nishyinda and Papaya and Probiotic on Performance and serum composition of broiler chickens. Annals of Biological Research **2(4),** 373-378.

Ndzi NH, Christian KT, Pascal MT, Ndamukong KJ, Buea P, Buea S. 2016. Effect of *Euphorbia hirta* and *Thymus vulgaris* powders on performance and haematological parameters of the Cameroon Kabir Chicken. Animal Health and Production **64(1),** 55-68.

Nghonjuyi N, Tiambo C, Kimbi H, Manka'a C, Juliano R, Lisita F. 2015. Efficacy of ethanolic extract of *Carica papaya* leaves as a substitute of sulphanomide for the control of coccidiosis in KABIR chickens in Cameroon. Journal of Animal Health and Production **3(1),** 21-27.

Nisha A. 2008. Antibiotic residues-a global health hazard. Veterinary world **1(12),** 375-377.

Ocak N, Erener G, Burak Ak F, Sungu M, Altop A, Ozmen A. 2008. Performance of broilers fed diets supplemented with dry peppermint (*Mentha piperita* L.) or thyme (*Thymus vulgaris* L.) leaves as growth promoter source. Czech Journal of Animal Science **53(4),** 169.

Pourmahmoud B, Aghazadeh AM, Sis NM. 2013. The effect of thyme extract on growth

performance, digestive organ weights and serum lipoproteins of broilers fed wheat-based diets. Italian Journal of Animal Science **12(3),** e53.

Ragaa NM, Korany RM, Mohamed F. 2016. Effect of thyme and/or formic acid dietary supplementation on broiler performance and immunity. Agriculture and Agricultural Science Procedia **10,** 270-279.

Saki A, Kalantar M, Khoramabadi V. 2014. Effects of drinking thyme essence (*Thymus vulgaris* L.) on growth performance, immune response and intestinal selected bacterial population in broiler chickens. Poultry Science Journal **2(2),** 113-123.

Schwarz S, Kehrenberg C, Walsh T. 2001. Use of antimicrobial agents in veterinary medicine and food animal production. International Journal of Antimicrobial Agents **17(6),** 431-437.

Sturkie PD, Bengo CA, Brown KI, Duke GE, Fedde MR, Glick B, Griminger P, Harvey AL, Harvey S, Hazelwood RL, Johnson AL, Kare MR, Kenny AD, Mason JR, Marshall IG, Meyer DB, Meyer DC, Ringer RK, Scanes CG, Wentworth BC, Whittow GC. 1986. Body fluids: blood. Avian physiology. Springer, p. 516.

Tadondjou D, Ngoula F, Kana J, Mube H, Teguia A. 2014. Characterization of reproduction of local Barred male chicken of the Western Highlands of Cameroon: Sexual maturity, fertility and sperm storage term in female. J. Phys. Pharm Adv **4(2),** 323-331.

Tellez G, Latorre JD. 2017. Alternatives to Antimicrobial Growth Promoters and their impact in Gut Microbiota, Health and disease. Frontiers in Veterinary Science **4,** 196.

Toghyani M, Tohidi M, Gheisari AA, Tabeidian SA. 2010. Performance, immunity, serum biochemical and hematological parameters in broiler chicks fed dietary thyme as alternative for an antibiotic growth promoter. African Journal of Biotechnology **9(40),** 6819-6825.

Toukala JP, Tadondjou CDA, Takor EO, Feugaing DDS, Nguepi MS, Vemo NB, Noubissi PA, Tchowan GM, Tiambo C, Ngoula F. 2020. Effects of dietary supplementation of *Thymus vulgaris* (Lamiaceae) on reproductive parameters in local Kabir rooster of Cameroon. Journal of Agriculture and Veterinary Science **13(3),** 13-22.

Wade M, Manwar S, Kuralkar S, Waghmare S, Ingle V, Hajare S. 2018. Effect of thyme essential oil on performance of broiler chicken. J. Entomol. Zool. Stud **6(3),** 25-28.

Zaoui A, Cherrah Y, Mahassini N, Alaoui K, Amarouch H, Hassar M. 2002. Acute and chronic toxicity of Nigella sativa fixed oil. Phytomedicine **9(1),** 69-74.

Zulkifli I, Hashemi S, Somchit M, Zunita Z, Loh T, Soleimani A, Tang S. 2012. Effects of Euphorbia hirta and virginiamycin supplementation to the diet on performance, digestibility, and intestinal microflora population in broiler chickens. Archiv für Geflügelkunde **76(1),** 6-12.