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# RESPONSE OF BROILER CHICKS TO DIFFERENT LEVELS OF EUCALYPTUS ESSENTIAL OIL

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## ABSTRACT

This experiment was carried out to evaluate the response of broiler chicks to diets supplemented with different levels of essential oils alone and/or a combination of them extracted from eucalyptus leaves (Eucalyptus Essential Oil, EEO) as natural feed additives. 112 day old, unsexed broiler chicks, Aber acre strain, were used in each experiment. Chicks were divided into four groups of 28 chicks in each experiment and each treatment group was subdivided into three replicates. The first group was fed on control diet, the 2$^{nd}$, 3$^{rd}$ and 4$^{th}$ groups were fed on diets supplemented with eucalyptus essential oil at 200, 400 and 600mg/kg diet, The experiment parameters covered growth performance, carcass and non- carcass values, serum constituents, enzyme activities and economical appraisal. The results showed that inclusion of EEO at 400mg/kg significantly improved body weight, body weight gain and feed intake compared to control group. However, there were no significant effects on the feed conversion ratio (FCR) and mortality rate. The results indicated that there were no significant differences among all treated groups in internal organs, commercial cuts, their separable tissues and the subjective and objective of meat quality parameters. The results of serum metabolites showed that inclusion of EEO at different levels significantly reduced the total protein, cholesterol and urine acid concentrations. However, the treatment effect on electrolytes and enzymes (SGOT and SGPT) activities was not significantly compared to control group. The result of economical evaluation of EEO in broiler diets showed economical benefits. However, 400mg/kg EEO recorded (1.14) profitability ratio. As a whole 400mg/kg EEO recorded the highest profitability ratio of the tested levels followed by 400mg/kg of eucalyptus essential oils.

**KEYWORDS:** Fenugreek essential oil, serum metabolite and electrolyte.

## INTRODUCTION

Growth promoting feed additives is an ingredient or combinations of ingredients added to the feed in relatively small amounts to fulfill a specific need, improve desirable properties or to suppress undesirable ones, hence increasing growth performance and live weight gain or egg output and improved feed conversion efficiency and lower mortality rate (Steiner, 2006; Abdel- Aal and Attia, 1993).

Antimicrobial feed additives such as antibiotics are often used alleviate stress result from intensive poultry production system (Pasteiner, 2006).

Today, the use of antibiotics has been banned due to their adverse and side effects on both animal and human health (Marzo, 2001; Halfhide, 2003; Botsoglou and Fletouris, 2003).

Predominantly organic acids, probiotics, prebiotics, symbiotic, phytogenic, feed enzymes, immune stimulants and aromatic plants and their extracts are commonly regarded as favorable alternatives natural growth promoters to antibiotic growth promoters, (Windisch *et al*., 2008).

Essential oils have been applied as potential feed additives (Nychas, 1995; Tuley de Silva, 1996; Lee *et al*., 2004). Also EOs or their components have been shown to exhibit hypolipidemic (Srinivasan, 2004), antioxidant (Kempaiah and Srinivasan, 2002; Botsoglou *et al*., 2004), digestive stimulant (Platel and Sirinivasan, 2004), antiviral (Bishop, 1995), antimycotic (Jayashree and Subramanyam, 1999; Mari *et al*., 2003), anti oxygenic (Ultee and Smid, 2001; Juglal *et al*., 2002), antiparasitic (Pandey *et al*., 2000; Pessoa *et al*., 2002) and insecticidal (Kontantopoulou *et al*., 1992; Karpouhtsis *et al*., 1998) properties as well as inhibition of odour and ammonia control (Varel, 2002).

Barbour, (2006) evaluated the impact of eucalyptus and peppermint essential oils in the protection of respiratory system of broilers against controlled challenges by mycoplasma gallispecticum and/or Avian Influenza Virus ($H_9N_2$). Also Awaad *et al*., (2010) reported that administration of eucalyptus and peppermint essential oils has a potent immune modulatory effect and evoke the immune response in chickens.

## MATERIALS AND METHODS

A total number of 112, day- old unsexed commercial broiler chicks, Ross 308 strain, were obtained from a commercial Poultry Breeders Company and transported to the student poultry premises, College of Agricultural Studies, Sudan University of Science and Technology, Sudan. After a week of adaptation period, chicks were divided randomly into four dietary groups, (A, B, C and D), each group was subdivided into three replicates each with seven chicks. Chicks were bought vaccinated against Gumboro disease at 14 then 23 days old and against Newcastle disease at 4 weeks age, soluble multivitamin compounds (Pantominovit. Pantex Holland B. V. 5525 ZG Duizel Holland) given to the chicks before and after three days of the vaccination in order to guard against stress.

The experimental house was semi closed oriented in an east- west direction. The roof is well insulated from trapezoid corrugated aluminum sheet and insulated of glass wool with thermal conductivity of 0.04 $w/m^2$. The house was equipped with adjustable side wall curtains to control the flow of the air into the house. The top and the bottom of the curtain opening was equipped with a curtain rod to minimize draft when fully closed, the floor was tightly constructed.

Mechanical ventilation system was used in the house to generate on one direction air flow to provide the requirement levels of uniformity of air distribution over wide range of climatic condition.

Fenugreek seeds were purchased from the local market, cleaned; fenugreek essential oil is obtained by steam distillation from the seeds (Trigonella foenum- graecum). The chemical composition of oil is determined by gas chromatography. Four experimental diets (A, B, C and D) were formulated to meet feed requirements of broiler chicks according to (NRC, 1994). Chicks on group (A) were fed on control diet, while chicks in groups B, C and D were fed on control diet supplemented with 200, 400 and 600 mg/kg fenugreek essential oil respectively.

Average body weight and feed consumption for each group were determined weekly throughout the experimental period. Body weight gain and feed conversion ratio (FCR) were calculated also weekly. Health of the experimental chicks was closely observed and the mortality recorded daily.

At the end of the experiment, 6 weeks old, the chicks were fasted overnight except water. Birds were weighed individually before slaughter by severing the right and left carotid and jugular vessels, trachea and esophagus. After bleeding, they were scaled in hot water, feathers removed manually, head removed closed to skull, feet and shank were removed at the hock joint, the visceral organs, liver, gizzard and heart were removed and weighed. Carcasses were washed and each one was divided into right and left sides by mid sawing along the ventral column. The left side was divided into three commercial cuts, breast, thigh and drumstick, each cut was weighed separately and deboned, then the meat and bone for each cut were weighed separately, the meat was frozen and stored for meat subjective and objective analysis.

Samples from the commercial cuts meat were thawed before cooking for sensory evaluation. The meat trapped in aluminum foil and roasted at 176℃ and about 80℃ internal muscle temperature. The cooked meat allowed cooling to room temperature. Ten well-trained panelists were instructed to evaluate meat samples for tenderness, juiciness, flavor and color following recommended procedure (Cross *et al*., 1978). Panelists used water between sample to clear the palate and pause between samples evaluated.

**RESULTS**

The specific chemical constituents of oils determined by testifying oil distasted from eucalypts leaves showed seven main chemical compounds; phellandrene, bicyclohptan, methylene and heptene were the main compounds.

Chicks group fed on 400mg/kg oil recorded significantly ($p<0.05$) the heaviest body weight compared to all tested groups, while chicks fed on 200 and 600 mg/kg showed significantly ($P>0.05$) low weight compared to control group.

Chicks fed on 400mg/kg oil consumed significantly ($p<0.05$) more feed followed by group fed on 600mg/kg oil. However, group fed on 200mg/kg consumed significantly ($P>0.05$) the lowest quantity of feed compared to all tested groups.

Chicks fed on 400mg/kg oil recorded significantly ($p<0.05$) the heaviest value for body weight gain compared to all tested groups. However, chicks fed on 600mg/kg oil showed significantly ($P>0.05$) the lowest weight gain (table 1).

For feed conversion ratio (FCR), there was no significant difference between the tested groups although the experiment period. However, group fed on 600mg/kg recorded numerically the lowest value compared to other tested groups.

**Table 1: Effect of adding different levels of eucalyptus on overalls**

| Treatment (gm/kg) | Body weight | Feed intake | Body weight gain | Feed conversion ratio |
|---|---|---|---|---|
| **Control** | $2262.67^{b}$ ±12.26 | $3604.00^{c}$ ±24.15 | $2086.00^{b}$ ±21.06 | $1.73^{a}$ ±0.05 |
| **200** | $2194.00^{c}$ ±15.88 | $3568.34^{d}$ ±19.10 | $2018.67^{c}$ ±18.02 | $1.77^{a}$ ±0.07 |
| **400** | $2421.33^{a}$ ±16.44 | $3872.67^{a}$ ±21.06 | $2231.33^{a}$ ±14.05 | $1.74^{a}$ ±0.04 |
| **600** | $2005.67^{d}$ ±18.70 | $3804.99^{b}$ ±18.02 | $1822.67^{d}$ ±25.00 | $2.09^{a}$ ±0.03 |
| **$Lsd_{0.05}$** | $9.5264^{*}$ | $17.5153^{*}$ | $16.8375^{*}$ | $0.7154^{n.s}$ |
| **SE±** | 3.1087 | 4.2076 | 6.5241 | 0.0837 |

Values are mean±SD.

Any two mean value(s) bearing different superscript(s) in a column are significantly different (P≤0.05) according to DMRT

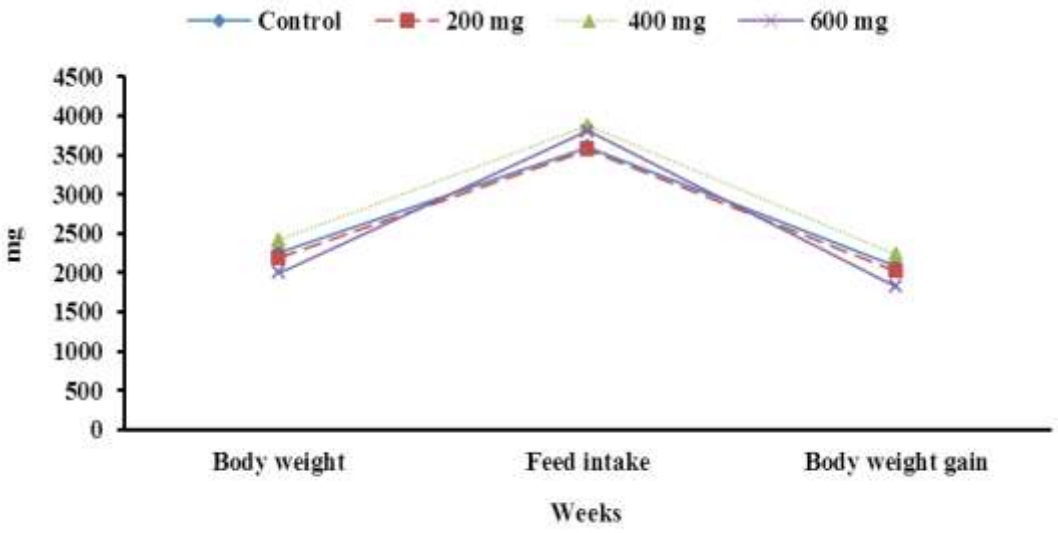


**Fig. 1: Effect of eucalyptus on overalls.**

Commercial cuts and their, their meat values and Non- carcass components (liver, heart, gizzard and intestine) (table,2) showed no significant (P>0.05) difference except for thigh for which group fed on 600mg/kg oil recorded significantly the lowest value compared to other tested groups. However, chicks fed on 200mg/kg oil recorded significantly (P>0.05) the

lowest value for abdominal fat compared to other tested groups which were showed no significant difference in abdominal fat among them.

**Table 2: Effect of adding different levels of eucalyptus on commercial cuts.**

| Treatments (gm/kg) | Wing | Breast | Drum stick | Thigh | Liver | Heart | Gizzard | Abdom-inal fat |
|---|---|---|---|---|---|---|---|---|
| Control | $11.20^{ab}$ ±0.78 | $34.27^{a}$ ±4.12 | $17.33^{a}$ ±1.15 | $15.47^{a}$ ±1.10 | $1.76^{a}$ ±0.45 | $0.403^{a}$ ±0.03 | $1.96^{a}$ ±0.23 | $0.94^{ab}$ ±0.06 |
| 200 | $11.73^{a}$ ±0.42 | $36.19^{a}$ ±4.05 | $16.78^{a}$ ±0.94 | $15.08^{a}$ ±0.68 | $1.66^{a}$ ±0.21 | $0.430^{a}$ ±0.03 | $2.31^{a}$ ±0.44 | $0.44^{b}$ ±0.38 |
| 400 | $10.46^{b}$ ±0.66 | $39.38^{a}$ ±3.75 | $16.48^{a}$ ±1.62 | $14.49^{ab}$ ±0.39 | $1.64^{a}$ ±0.04 | $0.400^{a}$ ±0.06 | $2.03^{a}$ ±0.33 | $1.13^{a}$ ±0.35 |
| 600 | $10.68^{ab}$ ±0.36 | $36.76^{a}$ ±2.07 | $16.85^{a}$ ±0.32 | $13.11^{b}$ ±1.12 | $1.75^{a}$ ±0.34 | $0.440^{a}$ ±0.02 | $2.33^{a}$ ±0.24 | $1.03^{a}$ ±0.16 |
| $Lsd_{0.05}$ | $1.095^{*}$ | $6.769^{n.s}$ | $2.088^{n.s}$ | $1.652^{*}$ | $0.565^{n.s}$ | $0.059^{n.s}$ | $0.60^{n.s}$ | $0.5156^{*}$ |
| SE± | 0.3357 | 2.076 | 0.6403 | 0.5066 | 0.1732 | 0.0183 | 0.1853 | 0.1581 |

Values are mean±SD.

Any two mean value(s) bearing different superscript(s) in a column are significantly different ($P \leq 0.05$) according to DMRT.

Chicks fed on 400mg/kg oil showed significantly lowest ($P > 0.05$) cholesterol concentration value compared to tested groups, simultaneously this group recorded significantly the highest values for uric acid and $PO_4$ concentration compared to the tested groups. Chicks fed on 200mg/kg oil showed significantly the highest Ca concentration in the serum while those fed on600mg/kg showed significantly the lowest Ca concentration (table, 3).

Experimental chicks fed on 600mg/kg showed significantly the highest SGOT although chicks fed on 200mg/kg showed significantly the lowest value. However, chicks of group fed on 600mg/kg showed significantly the lowest value for SGPT, although group fed on 400mg/kg recorded significantly the highest value compared to control group.

Chicks purchase, feed, electricity, management and labor values were the major inputs considered. The total selling values of meat is the total revenues obtained. Profitability ratio (1.14) of group fed on diet supplemented with 400mg/kg was the highest of the tested groups(table, 4).

**Table 3: Effect of adding different levels of eucalyptus oil on blood serum analysis.**

| Treatments (gm/kg) | SGOT (µL) | SGPT (µL) | T.P (g/dL) | Alb. (g/dL) | Cholest. (mg/dL) | Uric acid (mg/dL) | Ca (mg/dL) | $PO_4$ (mg/dL) |
|---|---|---|---|---|---|---|---|---|
| Control | $28.50^{c}$ ±0.28 | $4.60^{b}$ ±0.85 | $4.95^{a}$ ±0.19 | $1.97^{a}$ ±0.26 | $107.50^{b}$ ±5.36 | $9.25^{a}$ ±4.24 | $6.95^{d}$ ±4.56 | $3.15^{ab}$ ±0.13 |
| 200 | $15.30^{d}$ ±3.11 | $4.30^{b}$ ±0.0 | $3.47^{ab}$ ±0.65 | $1.70^{a}$ ±0.23 | $166.73^{a}$ ±9.80 | $8.32^{b}$ ±0.90 | $9.80^{a}$ ±0.41 | $3.17^{ab}$ ±0.17 |
| 400 | $47.45^{b}$ ±2.90 | $5.20^{a}$ ±0.0 | $3.55^{ab}$ ±0.65 | $1.90^{a}$ ±0.26 | $71.85^{d}$ ±4.81 | $9.00^{a}$ ±5.94 | $8.10^{b}$ ±0.14 | $4.00^{a}$ ±0.76 |
| 600 | $89.90^{a}$ ±0.0 | $2.00^{c}$ ±0.0 | $2.65^{b}$ ±0.21 | $1.77^{a}$ ±0.21 | $84.52^{c}$ ±1.99 | $7.65^{c}$ ±1.11 | $7.90^{c}$ ±0.94 | $3.10^{ab}$ ±0.08 |
| $Lsd_{0.05}$ | $10.832^{*}$ | $0.396^{*}$ | $0.027^{*}$ | $0.404^{n.s}$ | $12.532^{*}$ | $0.297^{*}$ | $0.851^{*}$ | $0.762^{*}$ |
| SE± | 3.417 | 0.198 | 0.015 | 0.297 | 4.976 | 0.093 | 0.267 | 0.254 |

Values are mean±SD.

Any two mean value(s) bearing different superscript(s) in a column are significantly different (P≤0.05) according to DMRT.

**Table 4: Sensory evaluation of chick's meat and Economical appraisal fed on different levels of Eucalyptus oil.**

| | Juiciness | Color | Flavor | Tender - ness | Total cost | Revenues | Profit | Profit ability ratio |
|---|---|---|---|---|---|---|---|---|
| 0 | 5 | 5 | 5.1 | 5.2 | 21.929 | 56.32 | 34.393 | 1.0 |
| 200 | 5 | 5 | 5 | 5.3 | 22.062 | 54.50 | 32.442 | 0.94 |
| 400 | 5.2 | 5 | 5.2 | 5.1 | 21.035 | 60.246 | 39.211 | 1.14 |
| 600 | 5 | 5 | 5.4 | 5.1 | 21.249 | 50.941 | 29.693 | 0.86 |

## DISCUSSION

Chemical analyses of eucalyotus leaf essential oil reported that phellandrene, dimethyline, tri methylene were the main compounds. These results were in line to some extent to those results obtained by Akin *et al*., (2010); Chalchat *et al*., (2001). They found that 1.8- Cineole., a- phellandrebe, p- Cymene and other constutiuents. However, Khaled *et al*., (2015) identified monoterpene hydrocarbons as the major constituents. The differentiation in the compounds concentration might be due to the varieties, age of leaves.

Results of feeding broiler chicks on different levels of essential eucalyptus oil (ECO) recorded that groups of chicks fed on different level of ECO showed positive significant differences in live body weight and body weight gain. However, group fed on diet supplemented with 400g/kg ECO recorded significantly the heaviest weight compared to other tested groups. This might be due to the therapeutic properties of ECO (**Cimanga *et al*.,** 20002, Khaled *et al*., 2015) and/or its bioactive products that showed antibacterial, anti-

fungal (Sui *et al*., 2006), anti- inflammatory effects (Simanga *et al*., 2002) and antioxidant activities (Siramon and Ohtani, 2007). However, no data are available in literature about the influence of ECO on broiler performance and carcass characteristics.

Results obtained revealed no significant effects on the commercial cuts and their meat yield also had no effect on the internal organs (liver, gizzard and heart).

Supplementation of broiler chicks with different levels of ECO significantly decreased the concentration of uric acid, total protein and cholesterol content with the increase of ECO levels in the diet. However, diet supplemented by 200g/kg ECO showed the lowest concentration for above mentioned parameters. On contrast, calcium content significantly increased with the addition of ECO in the diet, while the addition of ECO had no effect on the albumin and phosphorus concentrations in the blood serum between treated and non-treated groups under the conditions of the present study. These effects of eucalyptus oil observed might be attributed to the major constituents of eucalyptus essential oil (1, 8- cineol, α- pinene and pinocarveol- trans).

The blood serum analysis showed no significant differences in Serum Glutamic- Oxaloacetic Transferase (SGOT) and Serum Glutamic Pyruvic Transferase (SGPT) enzymes activities compared to the control groups. Eucalyptus essential oil can be good alternative to antibiotics without any negative effects as natural feed additive in broiler diet.

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