ADIPOKINES AND METABOLIC HORMONES OF BROILER ADMINISTERED SPICES ESSENTIAL OIL

Jimoh O.A., Akeredolu M.I. and Kayode A.P.

***Corresponding author:** abubakarjimoh2011@gmail.com. +234806658134

ABSTRACT

A study was conducted to evaluate adipokines and metabolic hormones of broiler chicken administered essential oils of turmeric, ginger, cinnamon and garlic. Essential oils (EO) of the four spices were extracted by steam distillation using standard procedures. The essential oils were administered to 200 a day old broiler birds randomly allotted to four treatments in a completely randomized design. The spices essential oils were added to water consumed by the birds at 30ml/L and standard diets were fed in a 42day feed trial. Blood samples were collected at the end of the trial, serum obtained and were assayed for metabolic indices. The result obtained indicates that. triiodothyronine of birds were not significantly affected by EOs. Insulin of birds on essential oils were statistically ($p<0.05$) lower than those of birds on control. Adiponectin of birds on cinnamon EO is significantly ($p<0.05$) higher than those of birds on garlic EO. Leptin of birds on garlic EO was significantly ($p<0.05$) higher than those of birds on cinnamon EO.

INTRODUCTION

Among alternatives to antibiotics growth promoters are plant extracts which are sources of bioactive molecules which elucidate effects on animal physiology and metabolism (Marcin *et al*., 2016). Herbs and spices have attracted attention in animal nutrition because of their potential to promote medicinal effects in livestock and poultry (Jimoh *et al*., 2018, 2022), as alternatives to antibiotic growth promoters. Essential oils (EO) are complex and highly variable mixtures of terpenoids (monoterpenes and sesquiterpenes) (Nazzarro *et al*., 2013) and concentrate and hydrophobic liquid of volatile aromatic compounds (aldehyde, phenol, methoxyderivative, polyphenols, terpenoids, saponins, quinone, esters, flavone, flavonoids, tannins, alkaloids, and non-volatiles residues) (Herve *et al*., 2019).

Plant-derived essential oils are among the potential alternatives, having exhibited various biological properties, such as antimicrobials, antioxidants, and immune-modulation (Su *et al*., 2021). Some EOs commonly used in broiler productions are oregano, cinnamon, ginger, garlic, thyme, and turmeric (Lee, 2003). Cinnamon bioactive compounds (cinnamaldehyde and transcinnamaldehyde) had been reported to stimulate secretion of growth hormone and its essential oils are have been reported to that have the ability to improve feed consumption and utilization in chickens (Krishan and Narang, 2014). Few studies have been carried out to compare the effectiveness of different spices essential oils on performances of broilers (Yang *et al.,* 2019). Further research is needed in order to fully evaluate the potential of essential oils in animal production (Adaszyńska-Skwirzyńska and Szczerbińska, 2017). Hence, the aim of this study is to assess the comparative effect of garlic, turmeric, ginger and cinnamon essential oils on metabolic hormones, biochemical indices and growth of broiler chickens.

MATERIALS AND METHODS

Fresh and mature garlic, turmeric, ginger and cinnamon were purchased from a local spices market within Ado-Ekiti metropolis of Ekiti State. They were peeled, diced and homogenized in water (40% w/v) and packed into a cooking unit for hydrodistillation in a Clevenger-type apparatus. The extracted essential oil was then dehydrated and stored in sealed glass vials below 4°C.

Two hundred (200) a-day old arbo acre broilers were purchased from a reputable hatchery. They were weighed and allotted to five treatments of 10 replicates and four birds per replicate in a completely randomized design. Birds were allotted to treatments such that control: No supplement, garlic EO: garlic essential oil, ginger EO: ginger essential oil, turmeric EO: turmeric essential oil, and cinnamon EO: cinnamon essential oil. An experimental basal diet was formulated to meet the nutrient requirement for broilers at starter and finisher phases. The spices essential oils were supplemented into drinking water (30ml/1L) for the birds throughout the study. Birds were fed *ad libitum* and fresh water was offered daily. The vaccination program as recommended by the hatchery were followed and no medication was offered throughout the study.

At the end of the feed trial, blood samples were collected from 3 birds per replicate into plain sample bottles for serum. Blood samples were centrifuged and serum obtained using standard procedures and stored at -20^{o}C until analysis.

Serum samples obtained were assayed for triiodothyronine and insulin, using enzyme linked immunosorbent assay, with commercial ELISA kits and its protocol for each assay.

- Triiodothyronine (T3) ELISA Catalog No. T3225T (Calbiotech Inc., 1935 Cordell Ct., El Cajon, CA 92020)
- Insulin ELISA kit, Catalog No. IS130D (Calbiotech Inc., 1935 Cordell Ct., El Cajon, CA 92020)
- Adiponectin ELISA Kit, Cat.No E0758Ra (Bioassay Technology Laboratory, www.bt-laboratory.com, 1008 Junjiang Inter. Bldg. 228 Ningguo Rd. Yangpu Dist. Shanghai. China)
- Leptin ELISA Kit, Cat.No E0561Ra (Bioassay Technology Laboratory, www.bt-laboratory.com, 1008 Junjiang Inter. Bldg. 228 Ningguo Rd. Yangpu Dist. Shanghai. China)

Data obtained from the study was tested using generalized linear model procedure of one-way Analysis of variance according to statistical analysis software IBM SPSS 20.

RESULTS

Metabolic hormones of birds on different spices essential oils are shown in Figure 1. Triiodothyronine of birds were not significantly ($p>0.05$) affected by the intake of essential oils of the different spices. Insulin of birds on essential oils were statistically ($p>0.05$) similar and significantly ($p<0.05$) lower than those of birds on control.

Adipokines of birds on essential oils of different spices is shown in Figure 2. Adiponectin of birds on cinnamon EO is significantly ($p<0.05$) higher than those of birds on garlic EO, while birds on turmeric EO, ginger EO and control were not significantly ($p>0.05$) different from those of other treatment. Leptin of birds on garlic EO was significantly ($p<0.05$) higher than those of birds on cinnamon EO. However, leptin of birds on turmeric EO, ginger EO and control were not significantly ($p>0.05$) different from those of other treatment.

Discussion

Although, increased levels of triiodothyronine were reported to affect the performance of chicken, result obtained in this study indicates that triiodothyronine was not influenced by the essential oils inclusion. Sadeghi and Moghaddam (2018), reported that thyroid hormones in broiler chicks that received medicinal plants had a tendency to increase. There are reported cases of reducing effect of herbal additives and flavonoids on thyroid function was reportedly due to catechin preventing the activity of thyroperoxidase and decreases the serum levels of T3 and T4 (Masoud-Moghaddam *et al*, 2021). Despite, Jianhua *et al*. (2000) claims that dietary selenium improves the growth of broilers due to increase in triiodothyronine because Selenium synthesize 50-deiodinase activity which catalyzes the conversion thyroxine to triiodothyronine. Birds on cinnamon and garlic EO-based groups had better growth rate than the other groups.

In this study, decreased level of insulin was associated with higher serum glucose in birds on garlic and ginger EO-based groups. This could be due to EO, insulin regulation of glucose conversion to fat, to reduce adipose fat accumulation. Chicken insulin can increase cell glucose intake mainly by the GLUT1 and decrease chicken appetite, especially in the low weight chicken (**Chuang *et al*., 2020**). As reported by Keita *et al*., (2013) that the presence of palmitic acid and oleic acid in olive oil lowered serum glucose level by optimizing insulin secretion in pancreas and improving body glucose uptake and utilization.

This study confirmed that garlic EO increased leptin expression, leptin which is a polypeptide hormone has been shown to regulate and maintain normal body weight (Yang *et al*., 2006). Leptin inhibits poultry appetite mainly by inhibiting neuropeptide Y receptor and agouti-related protein and upregulating the expression of pro-opiomelanocortin and melanocyte stimulating hormone (**Chuang *et al*., 2020**), explain higher feed intake and leptin in birds on garlic EO explain better performance in these birds. Contrariwise, garlic extract has been associated with suppression or loss of appetite and its oral administration shown to regulate lipid metabolism (Yang *et al*., 2019). This result confirms the expression of leptin by garlic EO and upholds the fact that garlic EO plays a significant role in energy metabolism and body fat regulation. The bioactive compounds in garlic has been found to stimulate gastro-intestinal emptying and facilitate defecation hence protecting the digestive system. (Ben *et al*., 2014; Shi *et al*., 2017). Cinnamon EO decreased leptin expression in the serum and the glucose level was not different from the control. The decreased leptin expression could suggest a decreased level of

adipose tissue accumulation as increase in leptin expression has been linked to increase in adipose tissue (Frederich, *et al*., 1995). Cinnamon has been associated with slowing down the absorption of sugar from the blood after eating high carbohydrate meal (Nicholas, *et al*., 2019) hence may affect the rate at which energy is produced and expended. This study confirms the influence of cinnamon EO on glucose regulation as well as energy metabolism through leptin expression activities. Cinnamon significantly increased the expression of adiponectin in the birds.

CONCLUSION

This study reveals that cinnamon and garlic essential oils exert superior growth promoting effects than turmeric and ginger essential oils due to their regulatory effects on metabolic hormones and energy metabolism.

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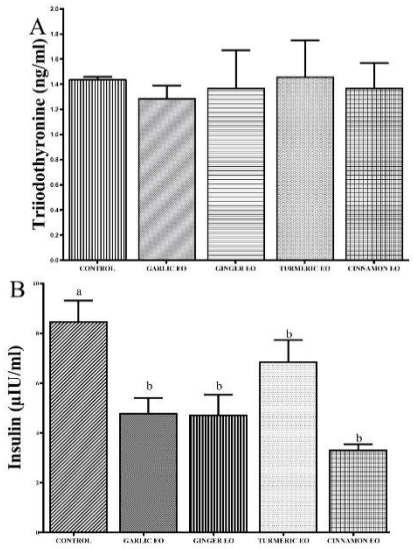


Figure 1: Metabolic hormones of broiler on spices essential oil
The effects of treatment are shown on (A) Triiodothyronine, (B) Insulin. ab: means with different superscripts are significantly (P<0.05) different: EO: essential oils

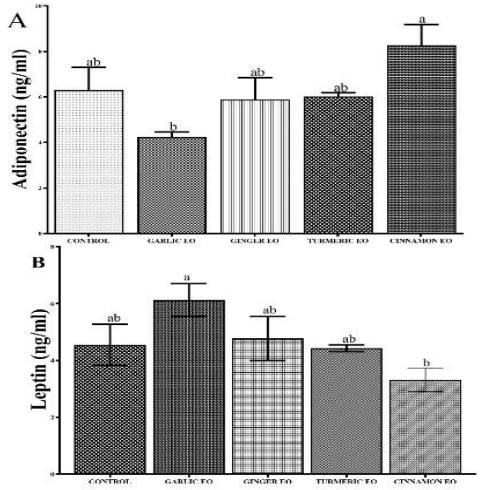


Figure 2: Adipokines of broiler on spices essential oil
The effects of treatment are shown on (A) Adiponectin, (B) Leptin ab: means with different superscripts are significantly ($P<0.05$) different; EO: essential oils