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by Edi Erwan

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Body Temperature, Feed Intake and Plasma Metabolites of Indigenous Chicks by Oral Administration of Watermelon Rind Extract with Two different Colors of Flesh: Yellow and Red

Erwan E[1]*, Irawati E[1], Nazir A[2], Fitra D[1] and Rodiallah M[1]

[1]Department of Animal Science, State Islamic University of Sultan Syarif Kasim Riau, Indonesia
[2]Department of Informatics Engineering, State Islamic University of Sultan Syarif Kasim Riau, Indonesia

***Corresponding author:** Edi Erwan, Department of Animal Science, Faculty of Agriculture and Animal Science, State Islamic University of Sultan Syarif Kasim Riau, Pekanbaru, Riau, Indonesia, Email: erwan_edi@yahoo.com

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Abstract

One of the challenge in poultry production is heat stress because of it tend to increase body temperature in chickens. Watermelon rind (WR) contain abundant of amino acid L-Cirtulline (L-Cit). Oral administration of L-Cit has been shown to have hypothermic agent that could improve thermotolerance in layer chicks. However, no information has been available for comparison of oral administration of WR extract (WRE) with two different colors of flesh: yellow and red in indigenous chicken. The present study was performed to examine whether oral administration of yellow or red WRE affect feed intake, body temperature and plasma metabolites in indigenous chicks. 5-day-old indigenous chicks were given acute oral administration of WRE (10 ml/kg) under control thermoneutral temperature (CT). Oral administration of both yellow and red WRE did not alter feed intake and body temperature and plasma metabolites in indigenous chicks. These results indicate that oral administration of yellow or red WRE may not alter thermoregulation, feed intake and plasma metabolites in indigenous chicks.

Keywords: Body Temperature; Indigenous Chicks; Feed Intake; Plasma Metabolites; Watermelon Rind

Introduction

The summer heat stress (HS) and global warming are becoming a serious concern around the world. It was reported by The Intergovernmental Panel Climate Change (IPCC) that the global surface temperature has been increasing [1]. Hence, summer HS is becoming more unbearable in not only in tropical but also subtropical countries. As environmental temperature is steadily increasing over the globe, HS is considered one of the major challenges for poultry production in some countries. Summer HS is causing a great economic loss in commercial poultry sector. Leeson, et al. [2] reported that the most important inhibiting factors to poultry production in hot regions is high ambient temperatures (HT), apparently because poultry cannot dissipate quickly the excess heat produced under HT, which subsequently leads to decrease performance with lower body weight gain in broilers and low egg production in layers with increasing mortality [3,4]. Compared with other domestic animals, birds are more sensitive to HT [5] as birds lack sweat gland and they rely on evaporative cooling (panting) to keep them cool [6]. Birds respond to hot environments by changing the circulating levels of hormones, glucose, leukocytes, electrolytes, and the functions of organs [7]. Detrimental effects of HT not only affect performance parameters, but also various physiological [8-12] and immunological [13] adaptations of

birds with the heat stress. The understanding of biochemical blood parameters is very important to define the biochemical profile, metabolism disorders, the energy metabolism, bone abnormalities, liver function and according of these factors could be used to determine the adaptation level of animals to climatic challenges [14]. Numerous reports have shown that in a HT, the concentration of glucose and total cholesterol in the blood decrease, which is an indicator of failure in homeostasis [15,16]. Several nutritional supplementations have been recommended to alleviate the negative effects of heat stress on the body temperature in poultry. For instance, providing essential or non-essential amino acids with or without conjugated with emulsifier of lauric acid in their diets [17-23]. However, nutritional manipulation with low cost involvement is a common approach in poultry industry [24].

Previous studies have been reported that oral administration of L-citrulline (L-Cit) decreased body temperature in layer chicks and afforded a degree of thermotolerance [25]. It is well known that the inclusion of synthetic L-Cit in poultry diets has not been approved in some countries, therefore one of alternative way might be the use of natural source of L-Cit from watermelon. Currently, this fruit is the third most popular fruit around the world and it also the largest consumed by people in hot weather, King, et al. [26] stated that according to designation of flesh color of watermelon, there are eight color: white, salmon yellow, orange, crimson red, scarlet red, pale yellow, canary yellow and green. Instead of its flesh, watermelon rind (WR) as agricultural waste has been reported contains rich of L-Cit [27,28]. The different color of flesh watermelon affect differences carotenoid contents [29]. We also have determined that L-Cit contents in red WR dried powder (WRP) was a greater than yellow WRP (*unpublished data*). Recently, it was reported that watermelon rind extract (WRE) contains 6638 pmol/mg [30]. Furthermore, Nguyen, et al. [30] revealed that oral administration of WRE significantly decreased body temperature in layer chicks. Similarly, in the previous study we found that oral administration of WRE decreased body temperature in broiler chicks (*unpublished data*). However, to the best of our knowledge, there has been no reports regarding the effect oral administration of different colour especially yellow or red WRE as a natural source of L-Cit on feed intake, body temperatures and plasma metabolites in indigenous chicks.

Materials and Methods

Experiment

Oral administration of WRE on feed intake, body temperature and plasma metabolites in indigenous chicks. One day-old (DOC) indigenous chicks were purchased from a local hatchery and housed in a wire-meshed cage (50 x 35 x 33 cm) in a group (2025 birds) at a constant temperature of 30±1°C and with continuous light. Chicks were all of the same age and were housed without any adult. Feed (Charoen Phokpand) and water were provided *ad libitum*. Feed composition is presented at Table 1. One day before the experiment, chicks (4 days old) were reared individually and assigned for treatment and control groups on the basis of their body weight in order to produce uniform groups.

Nutrient	Commercial ration
Crude Protein (%)	23.5
Crude Fiber (%)	1.88
Crude Fat (%)	5.87
Ca (%)	0.29
P (%)	0.15
ME (Kcal/kg)	3,050

Ca: Calcium, P: Phosphor, ME: Metabolizable Energy; *Commercial feed: CP511 PT, Charoen Pokphand, Indonesia; **Mineral Premix: Supplemented for kg of the diets: Vit. A, 12000 IU; D3, 2000 IU; E, 20 mg; K3, 3 mg; B2, 7 mg; B3, 12 mg; B5, 3 mg; B12, 0.03 mg; biotin, 0.1 mg; choline chloride, 300 mg; Mn, 130 mg; Fe, 70 mg; Zn, 60 mg; Cu,12 mg; I,1 mg; Se, 0.2 mg, and adequate antioxidant.

Table 1: The percentage of nutrient content in commercial ration.

Following a habituation period, chicks were randomly selected and divided into three groups each consisting of 10 chicks. The birds were reared individually in experimental cages and had *ad libitum* access to diet up to the time of the experiments. On the day of the experiment, each chick (5 days old) was orally administered distilled water, red WRE or yellow WRE by the elastic plastic needle on small syringe. The birds were fed *ad libitum* diets for 2 h immediately after the treatment. Feed intake (at 30, 60 and 120 min) was measured by calculating the reduction in the amount of feed consumed from a pre-weighed feeder. Similarly, body temperature of chicks was measured at 30, 60 and 120 min after. The weight of the feeder was measured using an electric digital balance. At the end of the experiments, birds were decapitated following anesthesia with isoflurane (Mylan Inc., Japan). Blood samples were collected in heparinized tubes and centrifuged for 15 min at 5,000g, and the plasma was collected and stored at 20°C until analysis took place.

Body Temperature Measurement and of Plasma Metabolites

A digital thermometer with an accuracy of ± 0.1°C (Thermalert TH-5, Physitemp Instruments Inc., USA) by

inserting the thermistor probe into the cloaca to a depth of 2 cm was used to measure the rectal temperature of chicks. The plasma metabolites, including glucose (Glu), total cholesterol (TCHO), total protein (TP), triacylglycerol (TG) were measured by Microlab 300 (Vital Scientific, Netherland) as per the manufacturer's instructions. The samples were assayed together and in a random sequence for each metabolite.

Statistical Analysis

A repeated-measures two-way ANOVA were applied for the analysis of feed intake and body temperature in Experiment 1. Plasma metabolites were applied by one way ANOVA. Tukey-Kramer test was performed as a post-hoc test. Significant differences were denoted as $P<0.05$. Values were presented as means ± S.E.M. Statistical analysis were the commercially available package Statview (1998). All data in each group were first subjected to a Thompson rejection test to eliminate outliers ($P<0.01$), and the remaining data were used for the analysis among groups.

Results and Discussion

Experiment Effects of oral administration of yellow or red WRE on feed intake, body temperature and plasma metabolites in indigenous chicks. As shown in Figure 1 body temperature did not change significantly ($P<0.05$) following oral administration of yellow or red WRE. Similarly, oral administration of yellow or red WRE did not significantly ($P>0.05$) alter feed intake (data not shown). Figure 2 shows the effects of yellow or red WRE on plasma metabolites. Similarly, oral administration of WRE did not significantly ($P>0.05$) alter TCHO, TG, Glu and TP. In the current study, we confirmed that oral administration both red and yellow WRE did not affect feed intake in indigenous chicks compared with a control group (data not shown). This results was consistent with previous studies. Ngunyen, et al. [30] demonstrated that oral administration of WRE failed to affect feed intake in 14-days old layer chicks. Other supportive data was reported by Chowdury, et al. [32] who demonstrated that oral administration of L-Cit did not influence feed intake in layer chicks. Similarly, Erwan, et al. [33] revealed that oral administration of L-Cit did not alter feed intake in KUB chicks. Additionally, Uyanga, et al. [34] and reported that dietary supplementation of L-Cit did not influence feed intake in laying hens. Furthermore, Poduri, et al. [35] demonstrated that supplemention of WRE did not alter feed intake in mice. In the light of information mentioned above and of the results from the present study, it might be suggested that oral administration of WRE or L-Cit seemed to similar effects on feed intake in domestic chicks or indigenous chicks and mice.

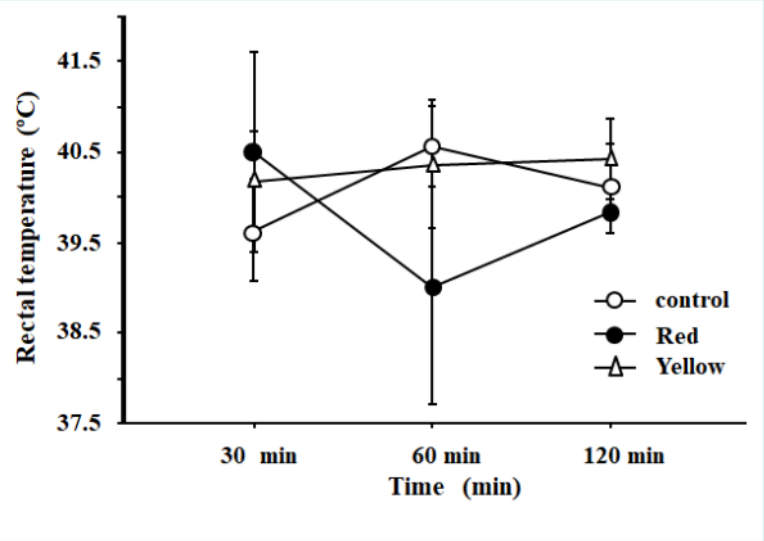

Figure 1: Effect of oral administration of yellow or red watermelon rind extract (WRE) on rectal temperatures in indigenous chicks during 120 min of the experimental period.

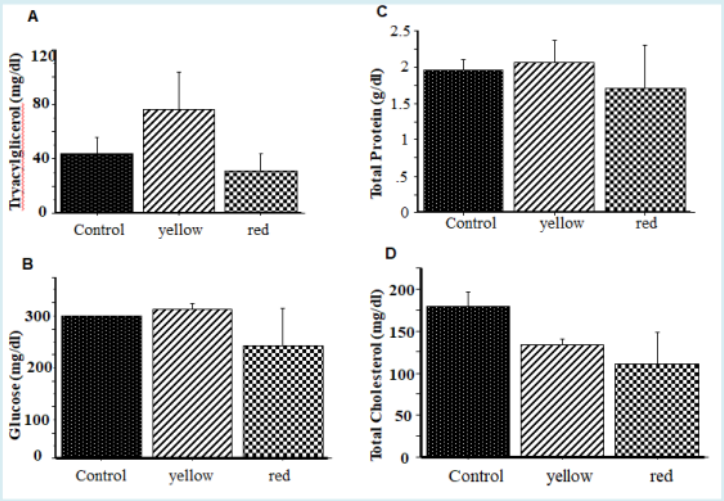

Figure 2: Effect of oral administration of yellow or red watermelon rind extract (WRE) on plasma metabolites in indigenous chicks.

We also demonstrated here that both red and yellow WRE did not alter body temperature in indigenous chicks. This finding is consistent with Uyanga, et al. [34] who revealed that dietary supplementation of L-Cit did not influence body temperature in laying hens. In addition, Poduri, et al. [35] also demontrated that there ware no differences in body temperature when mices were supplemented by WRE. Furthermore, Chowdhury, et al. [25] revealed that intracerebroventricular (i.c.v) of L-Cit failed to affect body temperature in layer chicks. However, the effect of WRE on body temperature differed with other reports. Nguyen, et al. [30] demontrated that body temperature was significantly decreased when layer chicks were orally administrated with WRE. Additionally, Chowdhury, et al. [25] revealed that oral administration of L-Cit significantly lowered body temperature in layer chicks. The reason for these discrepancies on body temperature in respon to oral administration of WRE or both i.c.v. and oral administration of L-Cit in birds perhaps due to varietas of watermelon, variations in experimental period, differences in doses, breed, strain or species. It is well known that indigenous breeds of chickens in tropical countries are better able to withstand high ambient temperatures than faster growing strains. Further experimentation would be needed to clarify the factors involved in this disparity.

Many factors may influence metabolic alterations in mammal and poultry such as physiological state, pharmacological condition, age, husbandry condition, genetic type and feed [22,33,35]. In general, the status of physiological of birds can be determined according to their hematological parameters and their concentrations are varied affected by dietary supplements. The absence of significant changes in the concentrations of TCHO, TG, Glu and TP in current study was consistent with previous study [32], Uyanga, et al. These findings alse were similar to the previous findings [33] who reported that there was no changes these plasma metabolites in KUB chicks following oral administration of L-Cit. This non-significant effect of WRE suggests that it does not affect blood cell formation, constituents and their function. We speculate that the short period of oral administration of WRE was not enough to alter the metabolic in the plasma metabolites.

Conclusion

To our knowledge, this is the first study to report oral administration of WRE may not alter feed intake body temperature and plasma metabolites in indigenous chicks.

Conflict of Interest

The authors declare no conflict of interest.

Acknowledgement

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