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Blood Gasses Contents of Green Turtle (Chelonia mydas) Hatch Treated by Different Temperatures

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The aim of this research was to gain the profile of blood gasses of green turtle (Chelonia mydas) hatch. Blood gas of the green turtle was analyzed after exposing them at 28°C and 50% of humidity for 24 hours in a pvc tube and at 34°C under sunlight exposed with 47% of humidity for 30 minutes. The result showed the different values of blood gas contents. This result showed indication of metabolism activities and poikilothermic adaptation of green turtle hatch. This information can be used to support for turtle hatchery in Indonesia.

Key words: green turtle, Chelonia mydas, hatched turtle, metabolism activity, blood gas contents

INTRODUCTION

Some of young vertebrates naturally had limited physiological and biochemical supplies on their bodies than that of adult. They have special hemoglobin characteristic of embryonic phase which soon would be matured along their growth phase. At each phase, hemoglobin binds oxygen in different affinity. For example, hemoglobin at embryonic phase has stronger affinity to oxygen than that of a mature phase (Wells & Baldwin 1989; Henry 2005; Wilson & Reeder 2008; Sharkey & Radin 2010).

It is known that adult turtle could survive in low oxygen concentration (hypoxia) environment (Wallace et al. 2005; Houghton et al. 2008; Misfeldt et al. 2009). The turtle is classified as hypoxia tolerant animals (Hochachka & Somero 2002; Storey 2004; Walsh et al. 2007; Doyle et al. 2008). Unfortunately, it has not been recognized yet about how far turtle hatch could survive in hypoxic condition. It is considered for turtle hatch after the eggs being laid down and drowned deep far away from the surface for about nine weeks. The oxygen concentration was decreased up to a half of oxygen concentration on the surface (Hicks & Wang 1999). Physiological conditions described in the hatchling phase shows that this is the most critical phase in all stages of development of turtle life cycle (Wells & Baldwin 1989). Critical phase of life cycle generally occur in hatchling phase period for almost all in vertebrate (Crossley & Alimiras 2005; Hubrecht & Kirwood 2010; Sharkey & Radin 2010). At this critical period, only two or three per thousand of turtle hatches population could survive to become an adult turtle.

Turtle hatch had short periodical life within intentional physical activities, and to survive it requires energy. The amount of energy consumption has positive correlation to the amount of lactate acid concentration in body plasma (Henry 2005; Sharkey & Radin 2010). This condition described transport of blood proteins during aerobe respiration (Storey 2004). This study provides information of turtle hatch biomass and turtle hatch metabolism condition through the analysis of blood gas after different temperature exposures which are reflected the image of hematogram. Therefore, this study was expected to give information of oxygen binding ability of turtle hatch blood cells. Furthermore, this information could give an explanation about turtle hatch metabolism and its adaptation in their natural habitat. Implication of this study is considered for physical training type that could increase the capacity of respiration system and also instrument of oxygen transport inside the blood to support its application in a turtle hatchery.
MATERIALS AND METHODS

Collection of Green Turtle Eggs. All of the following protocol concerning the green turtle (Chelonia mydas) eggs collection, condition for the raising, the hatchlings and method of experiments has been reviewed and agreed by an independent Ethical Code Committee of Department of Health Republic of Indonesia LB.03.02/KE/1479/2008. To obtain green sea turtle hatchling, their eggs were collected immediately after laid down in Pangumbahan Beach, Southern Sukabumi, West Java, one of several protected natural reserves for green turtle in Indonesia. All eggs were transported to the laboratory of the Department of Biology, Faculty of Mathematics and Natural Sciences, State Universitas Negeri Jakarta. Fifty eggs were incubated at room temperature (27-31 °C) for 45 days. The green turtle hatchlings were raised in a laboratory.

Temperature and Humidity Treatment. Eleven turtle hatch divided into two groups. Each group of turtle hatch was treated with different treatment of temperature and humidity. The first group consisted of five turtle hatches was treated by sunlight exposure for treatment of 34 °C and 46% of humidity for 30 minutes in experiment box sized 2 x 4 meter covered by sand from Pangumbahan Beach, West Java. While another group of six turtle hatches was treated inside a pvc tube containing sea water with temperature of 28 °C and 50% humidity. This treatment was set up to limit physical movement activity with the assumption that turtle hatch in minimal metabolism condition. Biomass weight and movement activity of turtle hatch were observed after the treatments. Parameters of movement activity during treatments observed were walking quickly from one corner to another of the experiment box and walking quickly with an irregular direction.

Blood Gas Analysis of Turtle Hatch. Blood samples were taken 0.5 ml from dorsal artery using 1cc syringe of each turtle. And all blood samples were analyzed directly by using ABL type 250 (Radiometer). The gas and chemical parameters analyzed were pH, HCO$_3^-$, O$_2$, HCO$_3^-$, P$_O^2$, and satO$_2$ (Leach et al. 1998; Nicolas 2002; Halliwell & Gutteridge 2007; Kapus et al. 2008).

RESULTS

Hatchlings Activities. The first five minutes at the beginning of sunlight exposure in at 34 °C with 46% humidity, all turtle hatches walked actively and spread out and along wide exploration area (unpublished data). However, after five minutes some turtle hatch started to decrease in their movement activity. And after 10 minutes of the treatment, there was no movement activity performed by all turtle hatches. Therefore the treatment was stopped after 30 minutes of sunlight exposure treatment. While the result of 29 °C exposure treatment indicated that turtle hatches were in a little movement after 24 hours treatment, although at the beginning of the treatment there was observed inactive turtle hatch. It seems that they tended to take a rest.

Blood Gasses Contents. In general, almost all blood gases parameters (CO$_2$, O$_2$, HCO$_3^-$, and satO$_2$) were decreased in hatchlings group treated by temperature of 28 °C (Table 1). However, the decreasing of blood gas parameter in this hatchling groups was not different from that of hatchling group treated by temperature of 34 °C (P > 0.05). Turtles of hatchling group treated by temperature of 34 °C had blood pH lower that of hatchling group treated by temperature of 28 °C. Decreasing in blood pH of the turtles indicated increasing rates of metabolism in the turtle’s body indicated by increasing levels of HCO$_3^-$ (Leach et al. 1998; Henry 2005; Kapus et al. 2008; Monastryskaya et al. 2008; Sharkey & Radin 2010) (Table 1).

Biomass Weight of Turtle Hatches. Turtle hatch treated by different temperature and mobility showed decreasing of weight between before and after treatments (Table 2). The data figured that the biomass weight of turtle hatches treated by temperature of 28 °C with limited activity condition for 24 hours was decreased up to 0.81 g. While biomass weight of turtle hatch treated by temperature of 34 °C for 30 minutes was decreased up to 0.42 g.

DISCUSSION

Turtle hatch blood gases contents were observed for two categories, under sun exposure of 34 °C for 30 minutes and under lower temperature of 28 °C for more than 24 hours. Turtle is a pochilotermic animal that depend on environment temperature. Based on those reasons, this research was done to observe the impact of

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Biomass weight of turtle hatch (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Before treatment</td>
</tr>
<tr>
<td>A</td>
<td>26.85</td>
</tr>
<tr>
<td>B</td>
<td>27.27</td>
</tr>
</tbody>
</table>

A: Treatment of 28 °C of temperature with 50% humidity for 24 hours, B: Treatment of exposure by sunlight at 34 °C with 46% of humidity for 30 minutes.

Table 1. Blood gas contents of turtles hatchling group treated by temperature of 28 and 34 °C

<table>
<thead>
<tr>
<th>Treatment</th>
<th>pH*</th>
<th>HCO$_3^-$</th>
<th>CO$_2^-$</th>
<th>O$_2^-$</th>
<th>P$_O^2$</th>
<th>satO$_2^*$</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>7.03±0.06</td>
<td>16.23±4.90</td>
<td>60.55±12.59</td>
<td>18.12±5.20</td>
<td>62.52±19.06</td>
<td>73.25±17.32</td>
</tr>
<tr>
<td>B</td>
<td>5.93±2.68</td>
<td>18.10±2.84</td>
<td>53.26±5.65</td>
<td>19.72±2.95</td>
<td>61.30±14.55</td>
<td>79.22±11.79</td>
</tr>
</tbody>
</table>

*: Average ± standard deviation, A: Treatment of 28 °C of temperature with 50% humidity for 24 hours, B: Treatment of exposure by sunlight at 34 °C of with 46% humidity for 30 minutes.
environment temperature on turtle hatch oxygen binding protein in aerobic respiration trough the measurement of blood acid–base (pH), oxygen level and blood carbondioxyde parameters (Leach et al. 1998; Hochachka & Somero 2002; Sharkey & Radin 2010) (Table 1).

The research result showed that physiologic adaptation ability run well in turtle hatch. It was proven by no turtle hatch died in research observation. The condition reflected turtle hatch ability and succeddy as poichilothermic animal to survive and adapt in environment temperature (Hochachka & Somero 2002).

To asses turtle hatch adaptation ability in environment temperature, blood gases were analyzed in turtle hatch exposed under sun light at 34 °C and treated under lower temperature of 28 °C. Turtle hatch group at lower temperature showed increasing of oxygen pressure (O_2). Furthermore, bicarbonate ion concentration (HCO_3) was decreased and oxygen saturation level was increased (Hartzler et al. 2006; Seebacher 2009). Despite, those values were not higher than oxygen saturation of turtle hatch group exposed under sun light. Values of O_2 and HCO_3 in both turtle hatch groups were not significantly different (P > 0.05).

Oxygen pressure, bicarbonate ion (HCO_3) dan oxygen saturation in both turtle hatch groups were dramatically changed. The explanation of these condition was oxygen pressure and saturation in turtle hatch blood describing respiration activity in common, whilst blood bicarbonate ion showed body metabolism activity (Hartzler et al. 2006; Ronco et al. 2009). Those three observed parameters indicated that turtle hatch group treated under lower temperature tend to had anaerobic respiration (Seebacher 2009; Sharkey & Radin 2010).

Oxygen saturation reflected body oxygen consumption of the organism (Henry 2005). Observation on turtle hatch treated under sun exposure had higher oxygen saturation. This condition showed that blood of turtle hatch exposed under sun light was having aerobic metabolism with high oxygen consumption. Based on Bohr effect, the higher CO_2 pressure in the blood the lower oxygen saturation level (Henry 2005). Means that the condition will enhance oxygen release from haemoglobin and send the oxygen to myoglobin.

Myoglobin has important function in hipoxic condition. In the condition of low partial oxygen pressure, myoglobin has wide oxygen saturation coverage. So, until some level of hipoxic condition, myoglobin will still be able to run body metabolism (Mooren & Volker 2005; Pupitaningrum et al. 2010) To increase and keep the tissue oxygen level, turtle hatch might enhance their tissue myoglobin expression (Fraser et al. 2006).

Acidity level is the most sensitive physiological parameter in human body (Henry 2005; Monastyryskaya et al. 2008) Slight changes on blood gases value will be followed by changes on blood and tissue acidity level. Blood and tissue acidity value show organism oxygen consumption. For that reason, acidity level will be able to use as an organism hipoxic status parameter (Leach et al. 1998; Monastyryskaya et al. 2008; Sabharwal et al. 2008; Sharkey & Radin 2010). Acidity level measurement for turtle hatch exposed under sun light at 34 °C in this research was lower than that of lower temperature of 28 °C (Table 1). Low blood acidity overview on blood turtle hatch at higher temperature indicated that this group was in hipoxic condition (Sabharwal et al. 2008). This group of turtle hatch was under enaerobic condition producing high amount of lactic acid. High amount of lactic acid in the blood will drastically decrease the blood acidity level (Sabharwal et al. 2008). This group of turtle hatch tends to increase their oxygen consumption in order to enhance their metabolism. The mechanism of increasing levels of oxygen in the blood is to support the turtle hatch metabolism adaptation in an extreme high environment temperature. Poikilotermic animals could survive in their environment by following the degree of body temperature in the surrounding environment (Vitt & Caldwell 2009). Therefore, the turtle group hatchlings at 34 °C need to increase the degree of body temperature in order to survive in conditions of high temperatures in their environment. To increase body temperature turtle hatchlings will increase blood levels of oxygen demand in order to increase the rate of metabolism.

**Biological Hatch Turtle Condition.** It was observed that the turtle hatchs in limited activity had significant decreasing of biomass weight it was up to 0.81g for 24 hours. A critical loss of weight probably caused by limited activity condition affecting turtle hatch in minimal physical movement and difficulty be able to eat well. However, the different pattern observed within a group of turtle hatch within optimal physical activity (threatened within sunlight exposed). Turtle hatch in this group had decreased of its weight up to 0.41%. Explanation of this condition was that metabolism condition of each group of turtle hatch aged one month treated in optimal condition. If the decreasing of weight correlated with the length of sun light exposure, so it indicated the ability of turtle hatch to survive in similar condition. The description of this metabolism condition is required to predict the real condition of turtle hatchs in their natural habitat, especially when turtle hatch was being hatched and starting to breath and reach the surface of sea shore. This description of metabolism condition was also useful as an explanation about survival opportunity of turtle hatch to keep a live for growing to the next phase up to a mature turtle.

The oxygen saturation value indicated the usage of oxygen inside the body. This value was high for the turtle hatch in optimal activity at temperature of 34 °C indicating a proportional oxygen supply for running aerobic metabolism. This group of turtle hatch increased its metabolism activity for adaption in order to support their survival in a natural habitat. It was supported by biomass weight data which were drastically decreased.

Turtle hatch phase is a crucial phase of turtle life cycle. Therefore, the success of turtle hatch to survive depends on opportunity and survival percentage to be an adult turtle. Therefore, the opportunity of turtle farming conservation especially for green turtle should be consider as an important action in order to conserve the turtle in their natural habitat.
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