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The colour preference of scalloped spiny lobster, *Panulirus homarus*

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Abstract. The background colour of a tank can affect the intensity of light that is absorbed or reflected. The objective of this research is to evaluate the colour preference of the scalloped spiny lobsters. Colour preference observations were carried out every half hour for 24 h. The result showed the spiny lobster had a consistent preference for black background (> 35%) and aversion to yellow, white, blue, and green background ($P < .05$) in the day. In the dusk, the spiny lobster had a consistent preference for red background (> 25%) and aversion to black, yellow, white, blue, and green background ($P > .05$). In the night, the spiny lobster had a consistent preference to red background (> 30%) and aversion to white and yellow background ($P < .05$). The number of lobsters moving towards the red tank continues to increase in the night rather than the dusk. Nocturnal activity is still going on the dawn.

Keywords: color background; lobsters; movement; preferences

1. Introduction

One of the factors that influence scalloped spiny lobsters cultivation is an environment factor following lobsters habitat. The tank colour is a physical parameter of the environment waters associated with brightness or light. Sense of sight lobsters will capture the light as information on environmental conditions waters. The colour of the housing can affect the light in the maintenance medium due to absorption, reflection, and refraction of light wavelengths. One way of engineering in the environment is the use of tank colours.

Tank colour can be a stressor through affecting the behavior, habitat preference, and metabolic rates of fish [1, 2] and crustacean [3, 4]. The response to background colour seems to be species specific [2]. Many studies have revealed that background colours of culture units significantly affected the growth and survival of cultured animal, such as barramundi (*Lates calcarifer*) [1], freshwater prawn (*Macrobrachium rosenbergii*), and snakeskin gourami (*Trichogaster pectoralis*) [5]. The growth, feed efficiency and survival of other species, such as spotted sand bass (*Paralabrax maculatofasciatus*) were not affected by tank colours [6]. The colour tank can affect the intensity of light that is absorbed or reflected back. Black Tank are light-absorbing and white tank are reflective [7]. The presence of too intense light can stress some cultivated organisms and die. The stressed cultured organisms have a low appetite so that the remaining feed on the rearing media is increasing. The objective of this research is to evaluate the colour preference of the scalloped spiny lobsters.



2. Materials and methods

The material used in this study was scalloped spiny lobsters (*Panulirus homarus*) with a size of ± 0.27 g, which is captured from the Ujung Genteng coastal waters, Sukabumi District, West Java Province. To find out the preferred colour of lobsters, 50 lobsters are placed in tanks with different colours, namely red, yellow, black, blue, green and white (figure 1). Observations were conducted for 30 minutes once the movement of lobsters to the preferred colour [8]. The distribution of the lobsters was recorded every 30 minutes, and the experiment last 24 h. The lobsters were tested in three replications. The cumulative appearance frequency (%) in one area was calculated as: Cumulative appearance frequency (%) = $(O_1 + O_2 + \dots + O_n)/n * 100\%$, where O is the number of individuals observed each time, and n is the number of observations [9].

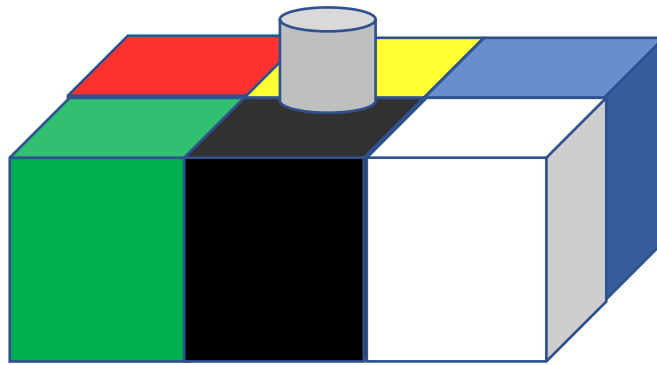


Figure 1. The sketch map of the colour preference device of experiment.

3. Result

3.1. The colour preference of *Panulirus homarus*

3.1.1 The red tank. The movement of spiny lobsters towards the red tank starts at 6.00 pm and continues until 11.00 am of the day after. However, the lobster began to move to another tank colour at 12.00 pm, it was seen that at least the lobster moved from the red tank at 12.00 (figure 2).

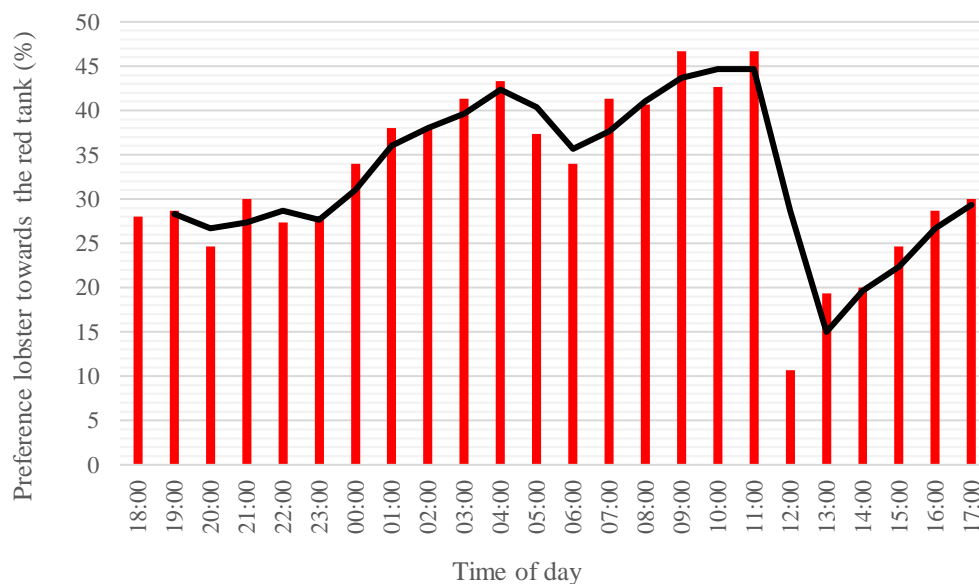


Figure 2. Preference lobsters towards the red tank.

3.1.2. The black tank. The movement of spiny lobsters towards black tank starts at 6.00 pm and continues until 8.00 pm. But after that, the number of lobsters that moved to black began to decrease, this happened until 11.00 am in the day after. (figure 3).

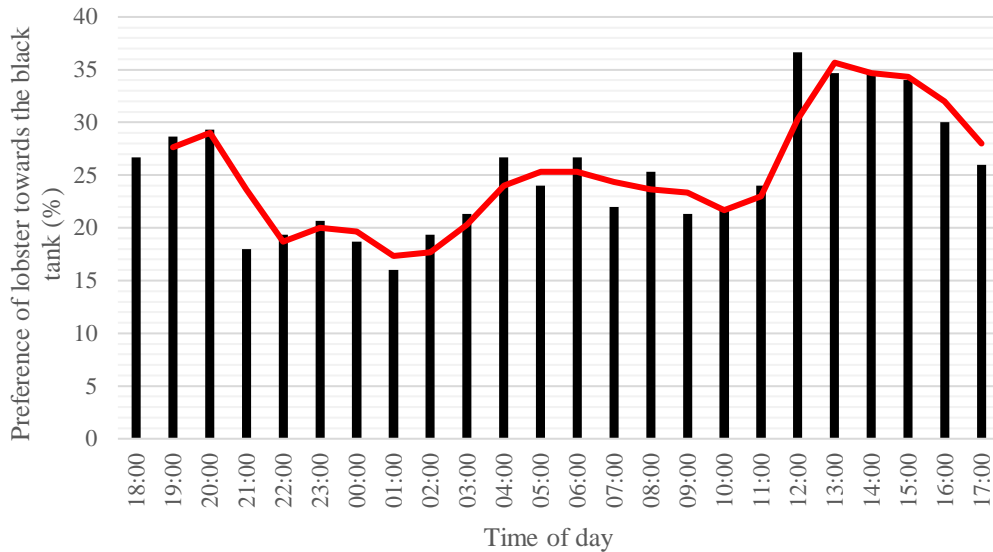


Figure 3. Preference lobsters towards the black tank.

3.1.3. The yellow tank. The movement of spiny lobsters towards yellow tanks tends to fluctuate. The number of lobsters moving towards the yellow tank continues to increase from 6.00 pm to 8.00 pm, but there was a decrease in movement starting at 9.00 pm (figure 4).

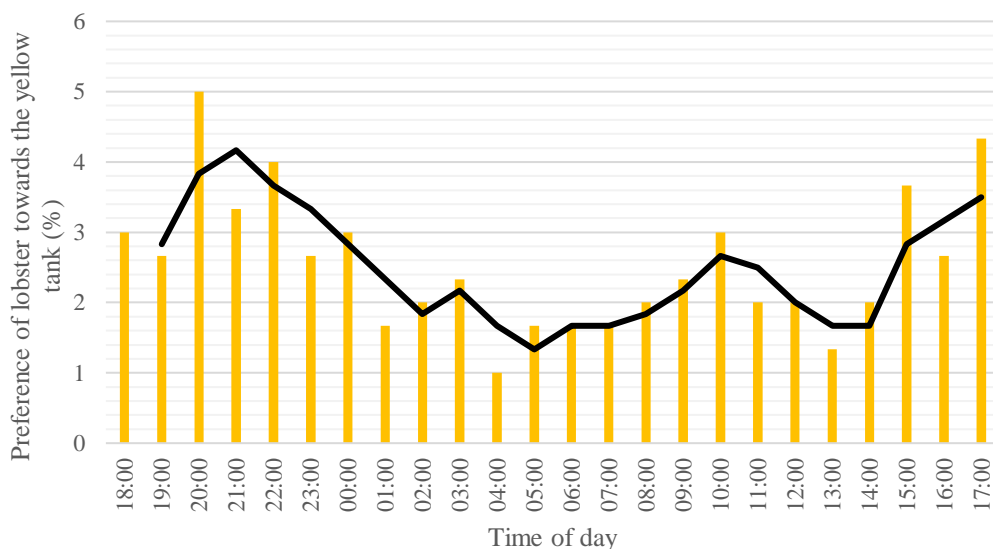


Figure 4. Preference lobsters towards the yellow tank.

3.1.4. The white tank. The movement of spiny lobsters towards the white tank tends to occur from 6.00-10.00 pm, but after that, the number of lobsters moving towards the white tank tends to decrease (figure 5).

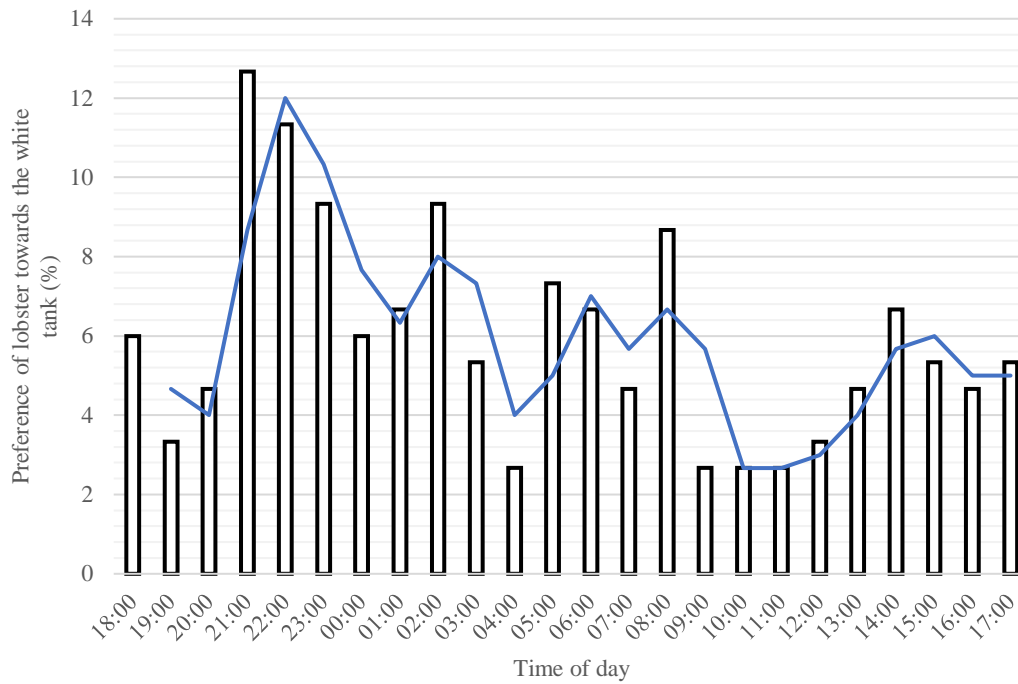


Figure 5. Preference lobsters towards the white tank.

3.1.5. *The blue tank.* The movement of spiny lobster towards the blue tank tends to be low at 12-00-02.00 pm. After that, the lobster movement towards the blue tank continued to increase (figure 6).

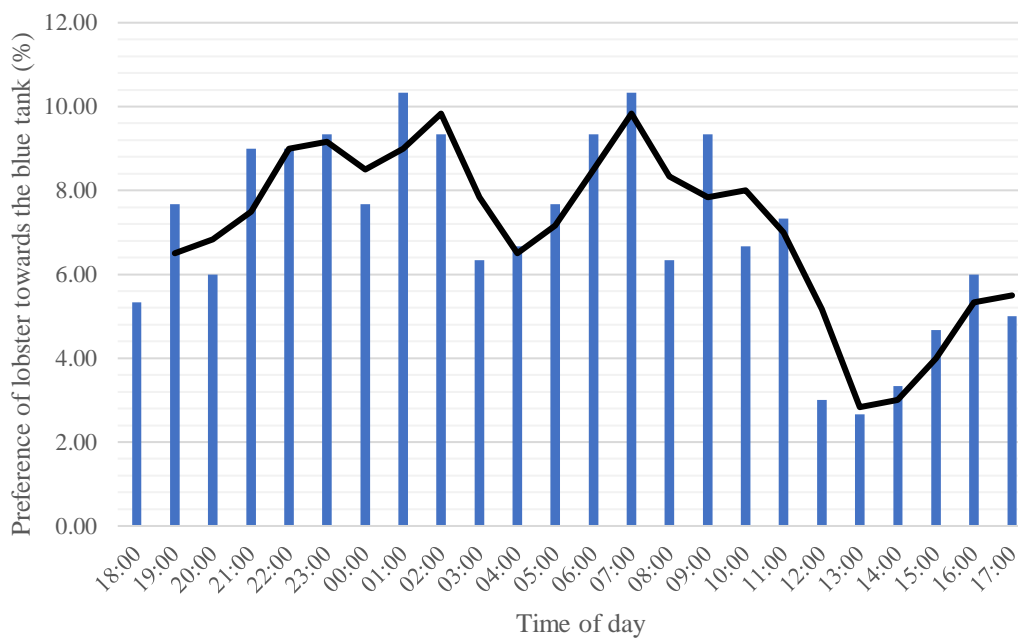


Figure 6. Preference lobsters towards the blue tank.

3.1.6. *The green tank.* The movement of spiny lobster towards the blue tank tends to be low at 11-00-12.00 am. After that, the lobster movement towards the blue tank continued to increase (figure 7).

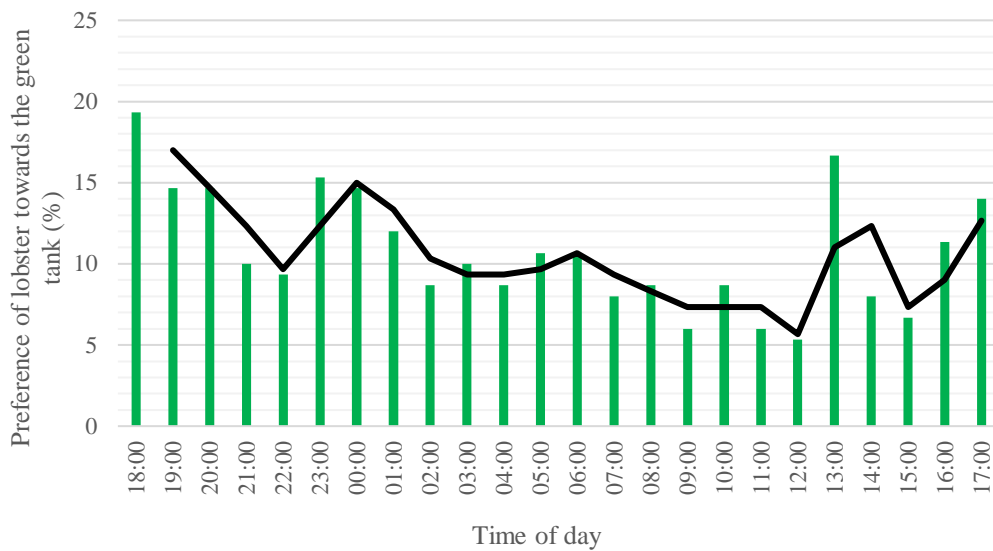


Figure 7. Preference lobsters towards the green tank.

3.2. *The colour preference in cumulative appearance frequency at day (12.00 pm), dusk (6.00 pm), night (24.00 am), and dawn (06.00 am)*

3.2.1. *Day (12.00 pm).* The spiny lobster had a consistent preference to black background (> 35%) and aversion to yellow, white, blue, and green background ($P < .05$) in the day (figure 8). The frequency of individuals occupying black background was not significantly higher than those occupied red background ($P < .05$).

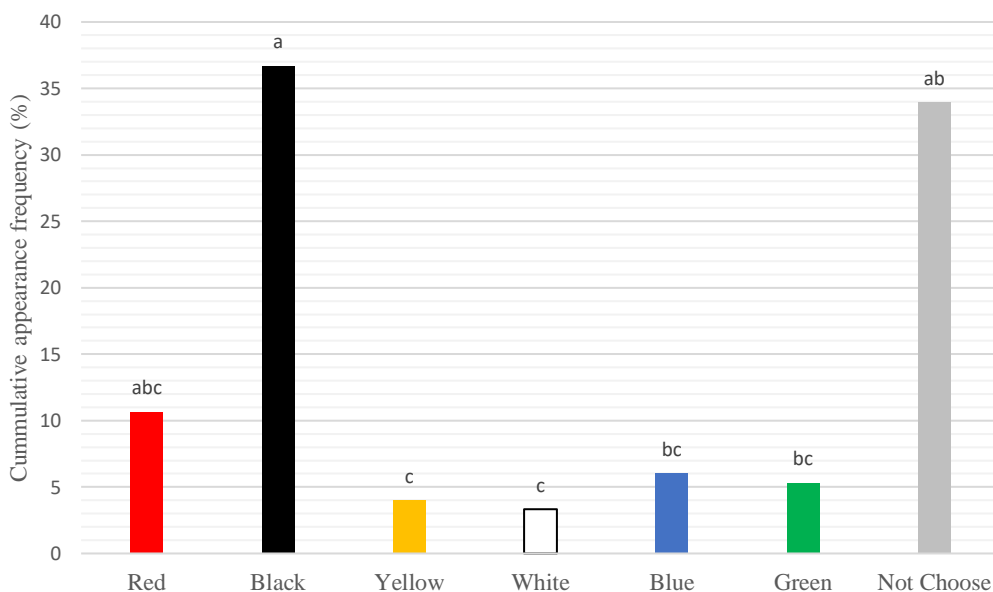


Figure 8. The colour preference of the lobster at 12.00 pm. Different letter indicates significant difference.

3.2.2. *Dusk (6.00 pm)*. The spiny lobster had a consistent preference to red background (> 25%) and aversion to black, yellow, white, blue, and green background ($P > .05$) in the dusk (figure 9). But in this time, there is an indication for lobster to starting to find the food.

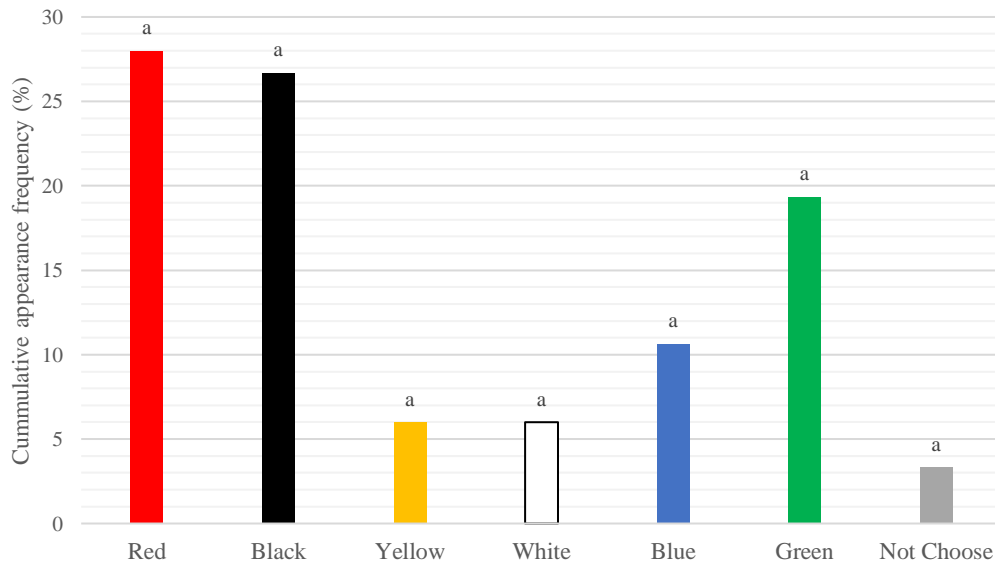


Figure 9. The colour preference of the lobster at 6.00 pm. The different letter indicates significant difference.

3.2.3. *Night (24.00 am)*. The spiny lobster had a consistent preference to red background (> 30%) and aversion to white and yellow background ($P < .05$) at the night (figure 10). The frequency of individuals occupying black background was not significantly higher than those occupied black, blue, and green background ($P > .05$).

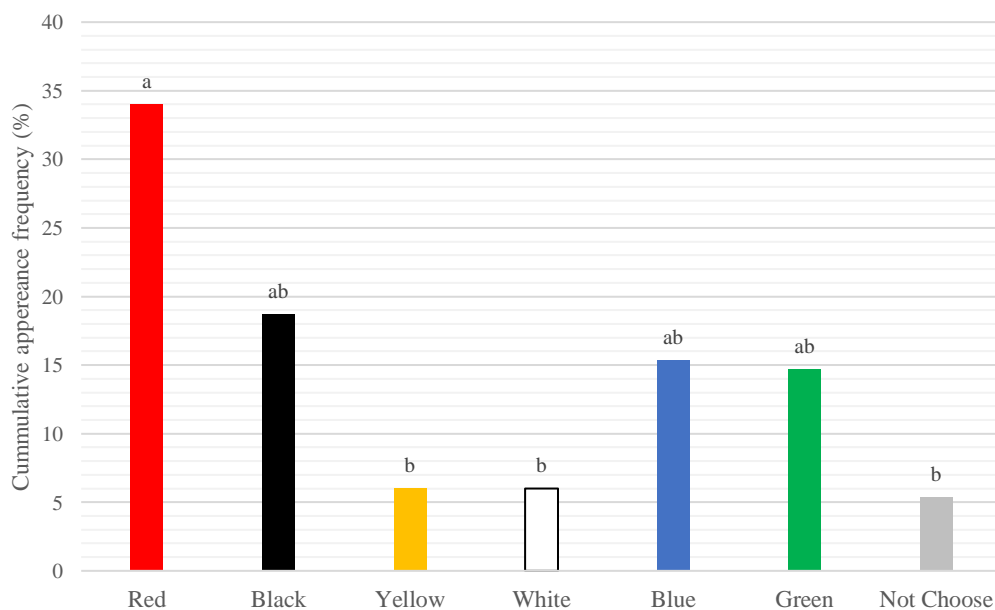


Figure 10. The colour preference of the lobster at 24.00 am. Different letter indicates significant difference.

3.2.4. *Dawn (06.00 am)*. The spiny lobster had a consistent preference to red background (> 30%) and aversion to white and yellow background ($P < .05$) (figure 11). The frequency of individuals occupying red background was not significantly higher than those occupied black, blue, and green background ($P < .05$). The activity of looking for food is still ongoing this morning before sunrise, this can be seen from the large number of lobsters gathered in red tanks.

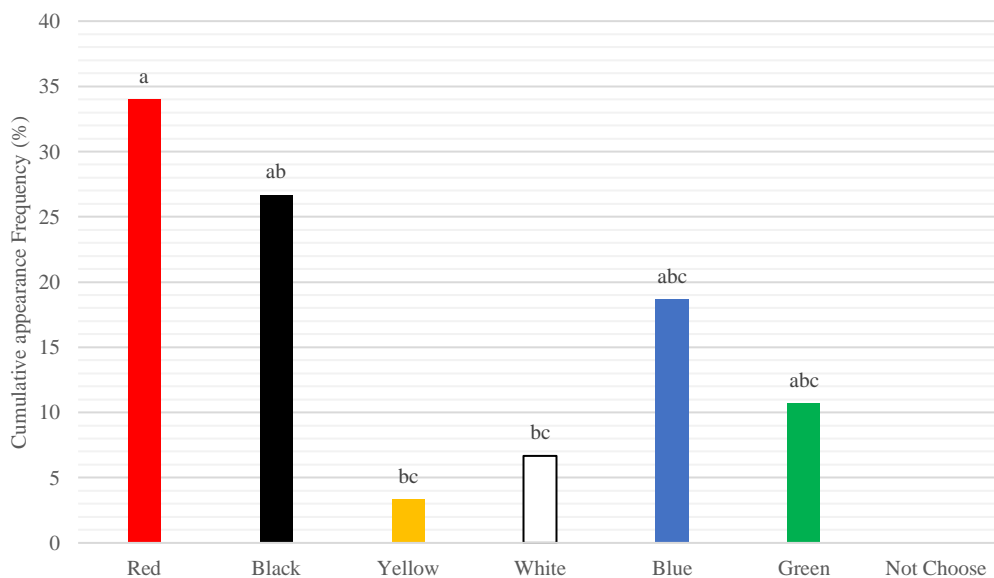


Figure 11. The colour preference of the lobster at 06.00 am. The different letter indicates significant difference.

4. Discussion

The large number of scalloped spiny lobsters that move towards the red tank at 18.00-11.00 is because lobsters are nocturnal animals where lobsters will looking for food in this time. Background colours of culture units have been reported to modulate the physiological and behavioral responses of the fish, such as feeding, growth, aggression, and stress response, through neural and hormonal processes. Stress responses are energy-demanding processes that may increase the catabolic processes of fish cultured, and in turn, reduce their growth rates [10].

The large number of lobsters that move towards the black tank at 12.00 is because lobsters are nocturnal animals where lobsters will hide in a darker place during the day. Nocturnal animals have a pattern where the highest activity occurs at the beginning of the night and activity stop when the sun rises. The behavior of lobsters in their habitat, where lobsters tend to hide in crevices, in caves, and other shelters to avoid predators. There are 6 species of predators that attack and eat lobsters during the day, namely *Balistes vetulla*, *Octopus vulgaris*, *Canthidermis sufflamen*, *Lutjanus analyst*, *Ocyurus chrysurus*, and *Gymnothorax vicinus* [11]. The results of research by Weiss *et al.* [11] showed that 70.96% of the incidence of attacks from predatory species during the day.

Many researchers suggest the use of black colour tanks for larval rearing, because many larval are positively phototactic, which causes them to orient towards reflective surfaces. This, in turn, causes the larvae to aggregate to the walls in light-coloured tanks, leading to stress, poor feeding and body damage, as has been reported in larval striped bass (*Morone saxatilis*) [12].

The dark-coloured diets provided better performance and survival of *L. ramada* than light-coloured diets. Similar results have been reported on Nile tilapia fingerlings, where fish fed the darker-coloured diets (red and dark blue) had better growth and feed efficiency than those fed lighter diets (yellow and light green). This preference may have been due to the contrast between the feed (dark) and the background (light), leading to higher visibility of the feed [10].

The activity of looking for food starts at this dusk (nocturnal), but the light intensity in the habitats is estimated low in this dusk so that at this time the lobsters tend to look for a slightly bright color. This condition can be seen by the number of lobsters moving in the red tank. The activity of looking for food is still ongoing this night, but the light intensity in the habitat is low at 24.00 so that at this time lobsters tend to look for a slightly bright color. This can be seen by the number of lobsters moving in the red tank.

The low number of lobsters headed for the white and yellow tank was caused the possibility for the inferior performance in the white background is that they were stressed. On a white color tank, most of the light is reflected back and not absorbed by the tank. This causes lobsters to seek shelter, given the nature of lobsters who actively forage at night (nocturnal). Therefore, there is a possibility that the poor adaption to unsuitable background also influence the feeding performance physiologically, eventually affected the survival and development [8].

The white background and unnatural lighting condition could be stressful compared with the black background could create more natural lighting conditions [8]. The larvae in the white background were attracted to the bottom of the tank for the light reflection, and thus became disoriented, which in turn affected their feeding success and made the larvae more vulnerable to pathogens [13]. The white tank is brighter and clearer because jundia catfish (*Rhamdia quelen*) have nocturnal habits, an environment with white tank are uncomfortable and affect fish behavior [14].

5. Conclusion

The lobster had a consistent preference to black background and aversion to white background in the day. However, lobster had a consistent preference to red background and aversion to white background in the dusk until the night. The low number of lobsters headed for the white tank was caused possibility for the inferior performance in the white background is that they were stressed or the poor adaption to unsuitable background.

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