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Steroid hormones regulated the cellular immune response of the crustacean

The endocrine system plays a crucial role in metabolism. Endocrine-secreted materials regulate the growth, development, reproduction, and immune response of organisms. In crustaceans, steroid hormones have been synthesized by feeding cholesterol as the precursor. Steroid hormones influence cell regulation by acting on the target cell nuclear membrane of receptors and binding to the appropriate gene ligand-binding domain, leading to cell gene expression and regulation of the immune system.

	Time / Ratio	0d	1d	2 d	4d	8d	16 d	30d
	Control	3.266±0.19^{a}	3.071±0.24^{a}	3.017±0.02^{b}	2.416±0.02^{bc}	2.739±0.15^{a}	2.340±0.10^{a}	2.745±0.09^{ab}
cortisone	2ppm		1.805±0.19^{d}	2.978±0.13^{b}	2.060±0.43^{cd}	2.558±0.10^{ab}	2.263±0.23^{a}	2.378±0.06^{bc}
	8ppm		1.689±0.21^{d}	2.279±0.51^{b}	1.892±0.20^{d}	2.595±0.37^{ab}	2.525±0.14^{a}	2.306±0.31^{c}
	32ppm		1.577±0.28^{d}	2.010±0.34^{b}	2.018±0.10^{cd}	1.961±0.12^{b}	1.880±0.07^{a}	1.788±0.31^{d}
20-hydroxyecdysone	2ppm		2.705±0.16^{ab}	5.166±0.34^{a}	2.635±0.07^{ab}	2.750±0.15^{a}	1.982±0.51^{a}	2.953±0.26^{a}
	8ppm		2.440±0.42^{bc}	2.921±0.22^{b}	2.632±0.19^{ab}	2.347±0.14^{b}	1.967±0.38^{a}	2.716±0.03^{ab}
	32ppm		1.917±0.43^{cd}	2.761±0.34^{b}	2.905±0.01^{a}	2.772±0.07^{a}	2.080±0.39^{a}	2.723±0.05^{ab}

Fig. 1. Phenoloxidase (PO) activity in the haemocytes of white shrimp (L. vannamei) fed diets with various concentrations of cortisone and 20-hydroxyecdysone. Values represent mean, and SD are parenthesized. a, b, c, d,: mean in the same column with the different latter are significantly different ($p < 0.05$). Values present with mean, and SD are parenthesized. a, b, c: mean in the same column with the different latter are significantly different ($p < 0.05$).

Ecdysone, 20-hydroxyecdysone (20-HE) is a naturally occurring ecdysteroid hormone found in crustaceans that has been synthesized in the Y-organs of the crustaceans; this hormone is secreted from the haemolymphs, hepatopancreas, ovaries, testes, and other haemolymph tissue. In this investigation, the effect of two steroid hormones on phenoloxidase activity, O_2^- production in the haemocytes, total haemocyte count (THC), superoxide dismutase (SOD) activity, glutamate oxaloacetate transaminase (GOT) activity, glutamate pyruvate transaminase (GPT) activity, and plasma cholesterol concentrations in white shrimps (*Litopenaeus vannamei*). Phenoloxidase activity, THC and plasma cholesterol concentration in shrimps treated with cortisone and 20-hydroxyecdysone were found to be lower when compared with the control groups. In the observation of O_2^- production, treatment of cortisone and hydroxyecdysone were reducing the activity in the 1st day, but to be undiversified with the elapsed time. By contrast, SOD activity in the hepatopancreas, plasma GOT activity, and GPT activity were significantly increased compared to the control groups.

On the first day of PO activity detection, PO activity was significantly reduced in the treatment groups compared with the control group, but there was no significant change in the 2 ppm 20-HE group. On the second day, the 2 ppm 20-HE group exhibited significantly higher activity compared with the control group. On the fourth day, the activity was significantly higher in the 20-HE group than in the other treatment groups and control, similar observations were noted on the eighth day. On the 13th day, the activity was significantly reduced in the cortisone groups compared with that in the other groups, as presented in the Figure 1. On the 16th day, no significant changes were noticed in any of the treatment groups.

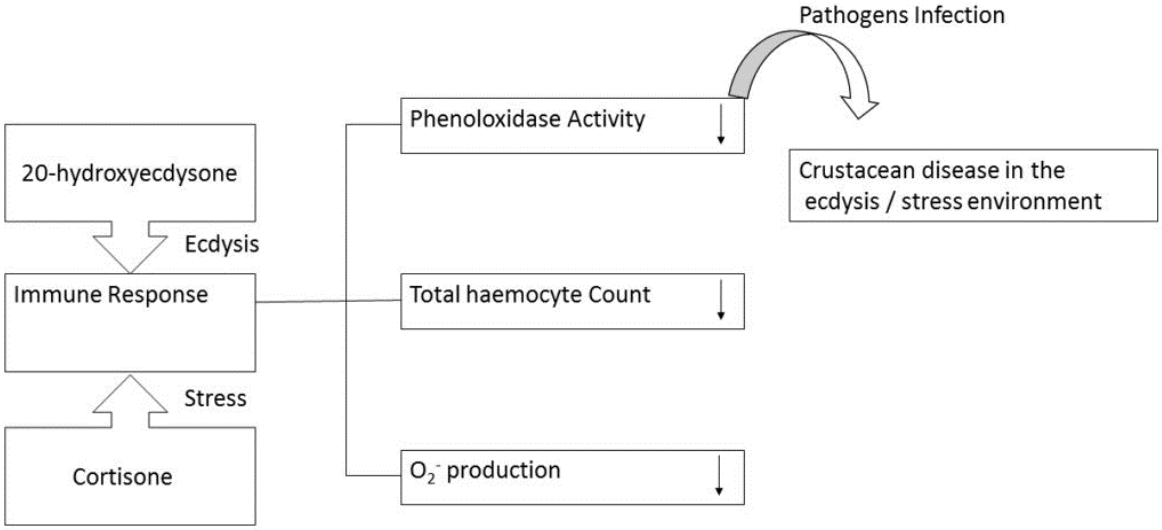

Fig. 2. Under the stress or molting environment, the arising steroid hormone role to reduce the immune response in the exchanged environment.

Steroid hormones play an important role in the crustacean molting process. This investigation was able to realize that the molting hormone affect the immunity of crustaceans. While increasing the molting hormone production, it will reduce the crustacean immune system response in the molting period. Due to the reduced immune response, it is leading to the crustaceans in the risk of non-protection while the pathogen infection moreover susceptible to death. On the other hand, this research also examined the impact of other steroid "cortisone" hormones on the immune system. Cortisone is a kind of stress hormones and, it will be produced while crustaceans facing to the alteration of environment following to make the homeostasis. Research indicated that crustacean produced cortisone reducing the immune response which is resulting to the crustacean facing to the risk of pathogen infection. The high concentration of cortisone in the crustacean is suspected to result to the crustacean death as the pathogen infection as presented as Figure 2.

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Publication

Steroid hormone “cortisone” and “20-hydroxyecdysone” involved in the non-specific immune responses of white shrimp (Litopenaeus vannamei).
Wu YS, Chang CH, Nan FH
Fish Shellfish Immunol. 2016 Sep