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Melatonin In Immune-Reproductive Crosstalk in Channa punctatus: A Strategy to Study

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Abstract

Melatonin is an evolutionarily conserved molecule. The chemical structure of melatonin is almost same from protozoans to mammals. Melatonin can exert its functions through its membrane bound receptors (MT1 and MT2). Among the multiple functions regulated by melatonin, the most important is immune-modulation. It is well reported that teleosts are having well developed pineal organ and it is having circulatory level of melatonin. It is also reported by some of the workers that the "snake-head" telost Channa punctatus is having the primitive type of immunogenic cells (if not a well-developed organ) on the dorso-lateral kidney. But, till date a single report is not available regarding the immune-modulatory role of melatonin in teleosts. The present study is aimed to discuss about the developments in this field till date and possible approaches to address the issue.

Keywords: Channa; Crosstalk; Immunity; Melatonin; Strategy

Introduction

Various studies suggest that immune system in vertebrates is affected by reproductive and endocrine systems. Melatonin mediated alterations of immune system in birds and mammals have been investigated by several studies. Melatonin is regarded as synchronizers of circadian and annual rhythms in the most animals including fishes [1]. Fluctuation in season has been implicated to alter the immune function, competence, and the incidence of onset of diseases [2]. However, the signaling pathway that control seasonal changes in immune functions have yet to be fully elucidated. Melatonin shows a robust daily circadian change in its synthesis. Two types of melatonin receptors have been found-low affinity MT3 and high affinity MT1, MT2 and Mel1c. Mel1c is specifically localized in non-mammalian cells [3]. Till date no report is available regarding the involvement of melatonin and its receptor in regulation of fish immunity. Further, a lot of literature provided clear cut evidence regarding immune regulation by melatonin in seasonally breeding rodents like Indian palm squirrel *Funambulas pennanti* [4,5]. Therefore, further investigations are needed to clarify the correlation of rhythmicity of melatonin with immune parameter and presence and signaling of its receptors (MT1 and MT2) on immune cells. Comparative melatonin research involving immune system and reproductive system will establish the pleiotropic effect of this magic hormone. Fundamental information on the pattern of melatonin receptor expression and crucial regulatory mechanisms remain incomplete and require novel approach and investigation using suitable cells and animal models.

International Status

Greater length of melatonin secretion during short days influences many processes in fish in which immunity is recently described by some authors [6,7]. Some studies have demonstrated the annual variation in leucocyte count in fish [8]. Differential pattern of leucocyte count has been confirmed in these studies differ and further studies in teleosts are needed to find a relation with season. The complement system represents a very pivotal defense mechanism in fish and consists of complex enzyme cascade [9]. More recently some authors have reported that complement activity fluctuates according to light-dark cycle [10]. Lysozyme activity has also been shown to fluctuate according to seasonal changes in photoperiod [10], however, no investigation has revealed the direct effect of melatonin on lysozyme activity. Contradictory results are available regarding oxidative burst function of immune cells in fishes [11]. Preliminary work in our laboratory shows that exogenous melatonin enhances the superoxide production and nitrite release from immune cells in *Channa punctatus*. Melatonin receptors, of low or high affinity, have been cloned in several fishes and the functional characteristics of these receptors have been determined [3]. Furthermore, additional integrative researches including melatonin and seasonal alterations on fish immune functions are essential to understand the signaling between melatonin and immune response.

National Status

In India, one study postulated the presence of day-night variation in phagocytic activity of macrophages in *Channa punctatus*. The authors reported that phagocytic activity increases during the light and the increase was inhibited by administration of melatonin [12]. Another group of scientist demonstrated that the serum lysozyme activity is related to the annual variation in season [13]. Pineal and gonadal relationship has previously been documented by a group of Indian author [14]. Some authors have also studied the role of adrenal hormones on fish and reptile immunity but interaction with melatonin was absent in these studies [12,15]. Majority of the work in India is confined to reproduction and cytoarchitexture and studies regarding melatonin and immunity are missing.

Proposed strategies to study:

- To determine the expression pattern of gene for melatonin receptor in immune cells of spleen and anterior kidney during different seasons (Circadian and circannual study).
- To investigate whether expression levels of melatonin receptor genes is related with reproductive cycle of *Channa punctatus.*
- Role of melatonin in alteration of cell mediated and innate immune functions and determination of expression of immune related genes.

Significance

Current proposal is aimed to find out a correlation between seasonality and immune response in fishes and a possible involvement of melatonin. Knowledge of daily and seasonal changes in immune responses may assist in devising a plan for improving the potential application of hormone assisted immune therapy. The effects of melatonin on numerous immune components such as cell mediated immunity and expression of melatonin receptor in immune cells have not been addressed. In mammals, increasing age has an influence on melatonin synthesis, but in fishes no data is available regarding maturity of fishes and pineal activity. Knowledge regarding age and melatonin synthesis in fishes will be helpful in broodstock management. This study will provide important insights into the changes in immune function by melatonin. In vitro experiments with melatonin will confirm the in vivo results. Immune parameters will also be measured after melatonin receptor antagonist (Luzindol) administration. This analysis will provide the signaling mechanism of melatonin in immune cells. Measurement of expression levels of various immune related genes will also be helpful in management of immune stress related mortality in fishes.

Conclusion

In the conclusion, we may suggest that the immune-modulatory role of melatonin in teleosts is an unexplored area of research. The present study is aimed to discuss about present developments and lacunae in this context and possible strategies to address it.

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