DOI : 10.35124/bca.2019.19.2.4185

Biochem. Cell. Arch. Vol. 19, No. 2, pp. 4185-4195, 2019 | www.connectjournals.com/bca | *ISSN 0972-5075*

IN SILICO ANALYSIS OF SSRS IN NEUROPSIN GENE IN VERTEBRATES

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(Received 22 May 2019, Revised 26 August 2019, Accepted 29 August 2019)

ABSTRACT : Simple sequence repeats or SSRs are tandem repeats of nucleotides of different lengths, generally from 1-6 bps, found in both prokaryotes and eukaryotes. These are hypermutable sequences and are associated with human genetic disorders. This study aims to analyse SSRs in *OPN*5 gene. This gene encodes a protein OPN5 or neuropsin which is a G_i-coupled opsin. The *OPN*5 gene is located on chromosome 6p12.3 in humans. The gene has seven exons and six introns in the coding sequence. This study has been done to compare human neuropsin gene with its orthologues in mouse, chicken, anole lizard, *Xenopus* and zebrafish, specifically on the basis of simple sequence repeats (SSRs). Most SSRs are present in intronic regions and are dinucleotide. The SSRs found may be used to study mutation in the gene due to their presence.

Key words : Opsin5, neuropsin, photoreception, SSRs, non-coding.

INTRODUCTION

Opsins are the photoreceptive membrane proteins, which are found in animals (Terakita, 2005). These are G-protein coupled receptor (GPCR) proteins which are sensitive to different wavelengths of light. Opsins form photopigment after coupling with a chromophore (Koyanagi and Terakita, 2014; Peirson *et al*, 2009; Terakita *et al*, 2012; Terakita and Nagata, 2014). Among the eight subfamilies of G-protein coupled receptor opsins, neuropsins are grouped under G_i-coupled opsins (Terakita *et al*, 2012; Terakita and Nagata, 2014). Neuropsins bind 11-*cis*-retinal, which is converted into all-*trans*-retinal after light absorption (Reviewed in (Terakita, 2005). These opsins are extraretinal photoreceptors (ERPs), found outside the retina of non-mammalian vertebrates (Pérez *et al*, 2019).

Neuropsin (NP) is encoded by *OPN*5 gene. *OPN*5 gene, also known as PGR12; GPR136; GRP136; TMEM13 (Gene ID: 221391), is located on chromosome 6p12.3 in humans. The gene has seven exons and six introns in the coding sequence (Tarttelin *et al*, 2003; Terakita, 2005).

Neuropsin was identified in mouse and humans in 2003. The protein comprises 354 amino acids in humans (Tarttelin *et al*, 2003). These proteins are present in the eye, brain, testes and spinal cord (Tarttelin *et al*, 2003) (Terakita, 2005). The localization of OPN5 in eye may link its role in light detection which further can be excluded by its presence in the brain (Tarttelin *et al*, 2003). The trigeminal cells also receive light through neuropsin and melanopsin. Even in the absence of rods, cones and melanopsin, mammalian retina and cornea show circadian photoentrainment due to the presence of neuropsin (Buhr *et al*, 2015; Van Gelder and Buhr, 2016), which is generated and maintained by oscillations in transcriptions of some clock genes such as *PERIOD* (*PER*), *CRYPTOCHROME* (*CRY*), *CLOCK*, *BMAL*1 *etc*. (Bruce, 1972; Feldman and Hoyle, 1973; Kondo *et al*, 1994; Konopka and Benzer, 1971; Millar *et al*, 1995; Ralph and Menaker, 1988; Tei *et al*, 1997; Vitaterna *et al*, 1994). However, another study suggests that neuropsin has only a limited role of excitatory light responses in the mammalian retina in absence of the rods, cones and melanopsin (Hughes *et al*, 2016). Nevertheless, it is observed that the retinal clock is disrupted in *OPN*5-null mice (Ota *et al*, 2018).

In birds, OPN5 acts as a deep-brain photoreceptor molecule which regulates seasonal reproduction (Kang and Kuenzel, 2015; Kuenzel *et al*, 2015; Nakane *et al*, 2010). OPN5 homolog shows violet sensitivity with the maximum absorption at 420 nm in quail (Nakane *et al*, 2010). Moreover, in chicken, it is observed that OPN5 is G_i-coupled bistable photopigment and localized mostly in retina, pineal gland and paraventricular organs. The 11-cis-retinal form of the chicken OPN5 has the absorption maxima of 360 nm and the all-trans-retinal form shows visible light sensitivity with the maximum absorption at 474 nm (Yamashita *et al*, 2010). In mouse and humans, the absorption maxima of OPN5 is in the UV (380 nm) and its photoproduct is in visible regions (471 nm) (Kojima *et al*, 2011). In frog tadpoles, OPN5 plays a protective