Asian Journal of Chemistry Vol. 18, No. 2 (2006), 1523–1525

NOTE

Spectral Characteristics of Iranian Firefly (*Lampyris turkestanicus*) Light

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Emission spectra of Iranian firefly *Lampyris turkestanicus* female has been measured with a fluoremeter. A simple technique of stimulation with mechanical triggering with a glass rod was found to elicit bright continuous emission over a period of several minutes. Emission peak arises from the abdominal lantern organs.

Key Words: *Lampyris turkestanicus*, **Firefly, Bioluminescence, Luciferin, Luciferase.**

Studies have shown that two species of firefly exist in the north of Iran. One of these, which is more available, has the scientific name *Lampyris turkestanicus* (*L.t.*) whereas the other is relatively rare and is named *Lampyroidea maculata*. These fireflies are known as *keng su kar* by the natives[1]. The basic study of bioluminescence was started by Dubois[2] on *Pyrophorous* fireflies. He extracted luciferin as a substrate, and luciferase as an enzyme by water from the lanterns of these insects. Luciferin in the American firefly *Photinus pyralis* was discovered by Harvey[3, 4]. The synthesis and chemical structure of luciferin were reported by White *et. al.*[5, 6] Beetle luciferase was isolated from different insects, such as fireflies (Family Lampyridae), click-beetles (Family Elateridae) and railroad worms (Family Phenogodidae). It is well established that the light emitted by different species of fireflies ranges in colour from intense green to bright yellow. The chemistry of the reaction and the structures of both substrates and emitter are identical for all insect luciferases. The main difference is in the colour of the bioluminescence. Fireflies emit yellow-green light (540–580 nm) *in vivo*[4, 7–9], click beetles emit in the wide range from green to orange[8, 10] and the railroad worms from green to red (536–638 nm)[11, 12]. The bioluminescence reactions

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carried out by a firefly use ATP as energy for an enzyme called luciferase to trigger a chemical called luciferin and involve oxidation reactions and an intermediate with an unstable four-membered ring. The firefly luciferin-luciferase reaction is remarkable in its efficiency, that is about 88% of the reacting molecules lead to the production of a photon[4]. The luminescent reaction in the firefly is able to achieve its high efficiency because of the enzymatic catalyst and because the luciferin directly emits a photon in the reaction. The mechanism[4, 13] of firefly bioluminescence is shown in Fig. 1

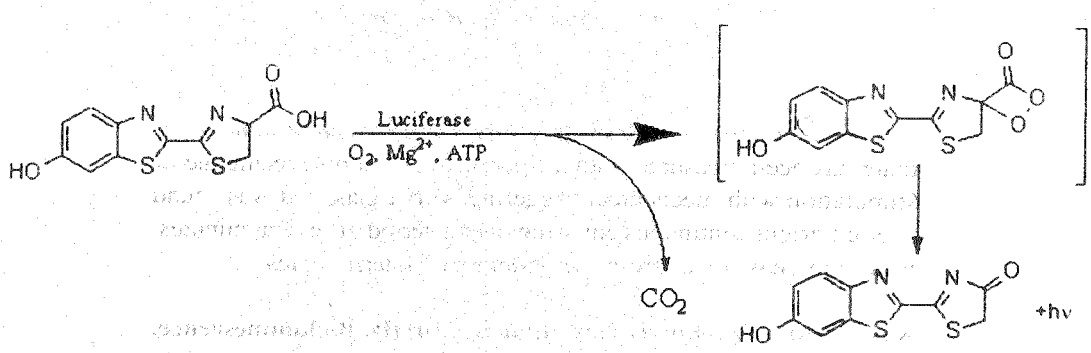

Fig. 1. Mechanism of firefly bioluminescence

Lampyris turkestanicus larvae and adult insects were collected from Mazandaran state in the north of Iran near rice farms and in the forest. In the laboratory, the larvae were reared in a net container with original soil and fed living snail. After about one year, the larvae transformed to adults.

The bioluminescence spectra were recorded on a model LS-50B Perkin-Elmer instrument. For studies of *in vivo* bioluminescence spectra, the animal was mounted in a spectrofluoremeter cell and placed in the cell compartment of the instrument. A simple technique of stimulation using mechanical triggering with a glass rod was found to elicit a bright continuous emission over a period of several minutes. Emission peak arising from the abdominal lantern organs was recorded.

The female of *Lampyris turkestanicus* has a more complex light organ than the male. It has two lines and two spot lanterns in the end of three bends of its abdomen and produces an intense light in the green-yellow region, similar to other Lampyridae. However, the male of this insect has only two spot lanterns, such as in the case of larvae. The male insect can fly but the female insect cannot. The maximum wavelength emission is 549.53 nm. The bioluminescence emission spectrum of *Lampyris turkestanicus* is shown in Fig. 2. The colour of firefly bioluminescence *in vitro* corresponds to the colour *in vivo* at neutral pH. The colour of light produced is determined by the properties of lucifrase, namely the microenvironment of the emitter in the active site of the enzyme[4, 7]. The luciferin in *Lampyris turkestanicus* is similar to that of the *Photinus pyralis* luciferin[1]. But the somewhat different colour of light produced by *Photinus pyralis* (562 nm)[8]

and by *Lampyris turkestanicus* arises from some differences between their lucifrases.

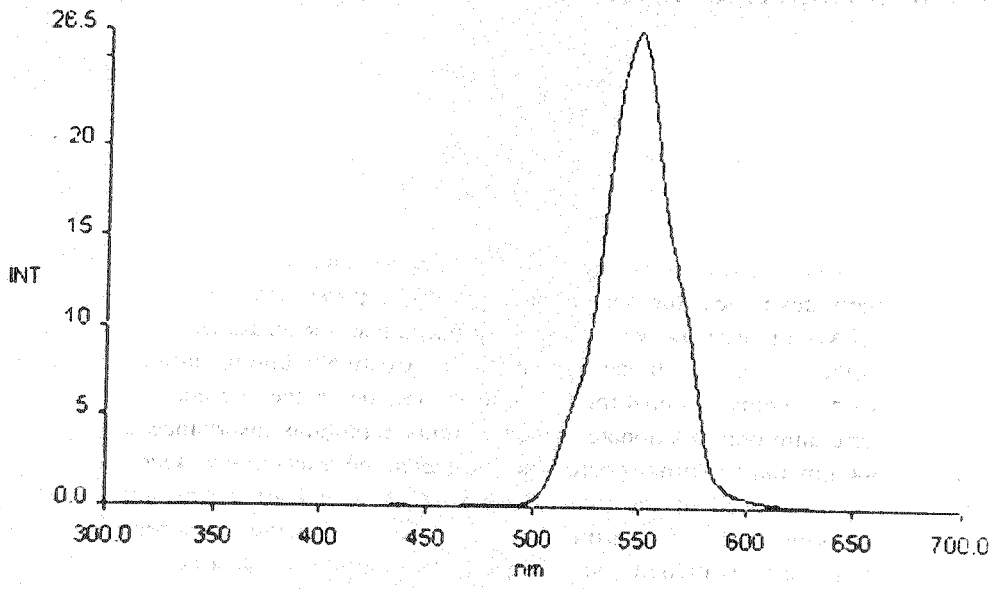

Fig. 2. Bioluminescence emission spectra of Iranian firefly (*Lampyris turkestanicus*)

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(*Received*: 20 September 2004; *Accepted*: 31 December 2005) AJC-4605