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Ocimum sanctum May Overcome Fatigue Stress

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Fatigue or tiredness is a state of physical and mental weakness. Its persistence for long time can cause chronic fatigue syndrome, the risk of this syndrome increases with an increase in exercise rate (Harvey *et al*., 2008). Moreover, it is also influenced by the one's personality and childhood body mass index. Exercise or some other activity induces fatigue in locomotor muscles, which affects the functionality of motor neurons (Amann and Dempsey, 2010). The raising muscle fatigue can slow down the activity of motor neurons, which increases the energy demands of body and limits its efficiencies. Fatigue results in an increased release of reactive oxygen species, which react with myofibril proteins of muscles and decrease the calcium regulation (Reid, 2008). This reaction with proteins and calcium loss, favor the oxidative pathological responses in body. The muscle fatigue may also be due the oxidation of CLC-1 (chloride channel), as in *Xenopus* oocytes (model organism) CLC-1 sensitivity to ATP (energy molecule) is only resumed after application of antioxidant (Zhang *et al*., 2008). That is to say, an oxidation stress in muscle results in CLC-1 inactivity, which stops the metabolism of ATP. Muscle fatigue cause oxidation of glutathione; it is an important thiol necessary for nutrients metabolism, regulation of apoptosis, cell growth, DNA and proteins synthesis (Wu *et al*., 2004). It is also involved in antioxidant defense mechanism of body, thus its loss will put a huge burden on health. Hence, this can be said that oxidative stress is the major contributor for fatigue related health problems. This oxidative stress has an important role in chronic fatigue syndrome also and can be inhibited by the application of antioxidant plants and plant products (Logan and Wong, 2001). Plants are important source of antioxidant compounds and they exhibits free radical scavenging property, which can help in treating various diseases (Gupta *et al*., 2008). This property of plant is due to the presence of several natural antioxidants. Thus to treat the oxidative stress of fatigue, a great help can be obtained from plants.

Plants with significant medicinal importance are extensively used by people to treat various health problems (Malik *et al*., 2011). *Ocimum sanctum* is locally found in many areas and due to significant medicinal importance usually studied for its genotypic and biochemical diversity (Ahmad and Khaliq, 2002; Shukla and Shukla, 2010; Karim *et al*., 2011; Sohail *et al*., 2011). In a recent research Prasad and Khanum (2012) found its antioxidative activity to decrease fatigue in Wister albino rats. They supplied different concentrations of 70% ethanolic *O. sanctum* extracts to animals and passed them from weight-loaded forced swimming test. Daily forced swimming exercise caused significant fatigue in animals, which resulted in decreased level of hemoglobin and liver-muscle glycogen (stored energy). Their decreased levels were responsible for oxidative stress and reduced energy supply. Fatigue also caused an increase in lipid peroxidation, lactic acid, Blood Urea Nitrogen (BUN) and Creatine Kinase (CK) levels. These increased levels were due to muscles damage, liver and kidney impairment. Thus fatigue induced a poor effect on hemoglobin, muscles, liver and kidney, which would pose significant burden on animals health. But the implementation of *O. sanctum* extracts saved the animals from these severe losses, in concentration dependant manner. The daily supply of these extracts increased the swimming time of animals, by day 10 the endurance of animals increased with an increase in extracts concentration. While after day 10, high fatigue endurance was noted in animals supplemented with 300 mg kg^{-1} b.wt. Thus 300 mg kg^{-1} b.wt. supplementation of *O. sanctum* ethanolic extract was most effecting in reducing muscle fatigue. Furthermore, *O. sanctum* was also effective in maintaining the blood levels of hemoglobin, BUN and CK. As a significant increase of hemoglobin levels were noticeable in plant treated animals and most promising effects were produced by 300 and 450 mg kg^{-1} b.wt. concentrations. In these animals BUN levels were maintained by the 450 mg kg^{-1} b.wt., while CK levels were reduced by the 300 mg kg^{-1} b.wt. concentration of extract. Moreover the extracts were also able to inhibit the lipid per oxidation in muscles, brain and liver, in this regard 450 mg kg^{-1} b.wt. concentration was most effective. The extracts were also effective in maintaining elevated levels of lactic acid, which was a key product of anaerobic pathway. The 300 mg kg^{-1} b.wt. concentration of extract was found to be most effecting in lowering its levels in muscles and liver, thus protected them from anaerobic fatigue. Its 300 mg kg^{-1} b.wt. implementation was also effective in modifying the glycogen levels, as it helped in resuming the glycogen

level both in muscles and liver. Thus *O. sanctum* showed many protective effects to revive body's energy, reduced by over exercise (swimming). Since, its 400 mg kg^{-1} b.wt. concentration was most effective in maintaining BUN, hemoglobin and lipid peroxidation levels, but 300 mg kg^{-1} b.wt. showed positive effect on maximum parameters. So this can be said that *O. sanctum* extracts in concentration of 300 mg kg^{-1} b.wt. were efficient in reducing fatigue and could be used to treat tiredness.

Plants are an important part of living environment and they have many healthy effects on human health. As Prasad and Khanum (2012) through their research on *O. sanctum* proposed it as an anti-fatigue agent. The application of its ethanolic extracts helped a lot in lessening fatigue and increasing the swimming stamina of rats. Thus there should be research on phytochemical and remedial treasures of *O. sanctum* to help the exercise loving peoples and athletes.

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