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## Snakehead Fish (*Channa striata*) and Its Biochemical Properties for Therapeutics and Health Benefits

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### Abstract

Snakehead fish is largely used for food, traditional medicines and pharmacological therapeutics including anti-microbial, anti-inflammatory, cell proliferation, induction of platelet accretion and anti-nociceptive activities. Snakehead extract contains high levels of essential amino acids and a good profile of fatty acids that could directly improve tissue growth, wound healing, nutraceutical supplements and pharmaceutical products. It contains essential fatty acids, indicating the abundant presence of 30% C16:0 along with other major fatty acids of C20:4 (19%), C18:0 (15%), C22:6 (15%) and C18:1 (12%). It also contains 19.0% of arachidonic acid (C20:4), a precursor for prostaglandin and thromboxane biosynthesis, which represents the best composite for wound healing processes. Individually in fillet and mucus extracts of snakehead is found to exhibit a concentration dependent antinociceptive activity. Recently snakehead fish has been used as biomedical and nutraceutical products for clinical trials, treatment of several chronic diseases as well as improvement of human health and therapeutics to a greater extent.

**Keywords:** Biochemical properties; Antinociceptive activity; Therapeutics; Pharmacological activity

### Introduction

The snakehead fish (*Channa striata*) (Figure 1), is locally known as 'Shoal' in Bangladesh. It is fresh water fishing the Southeast Asian countries and considered as a source of high quality protein and traditional remedy of sickness. Snakehead is not only the healthy diet to eat and relish but are often used as medicine for various diseases [1]. It is a one of the most common fish among the local populace with traditionally identified pharmacological benefits in treating wound and pain and in boosting energy of the sick. However, snakeheads are yet to be fully explored source of medicines, despite they are well known ingredients for many popular medicines and also recognized by current and past pharmacopoeias around the world [2]. The fish is carnivorous and consumes fish, frog, snakes, insects, earthworms and tadpoles, therefore its flesh claimed to be rejuvenating, particularly for those recuperating from a serious illness [1]. The popularity of *C. striata* as a therapeutic agent is related to folk belief in its efficacy in treating wounds, relieving pain and boosting energy, and herein lead to the normal or caesarean delivery, patients recovering from surgical operations are routinely and customarily advised to eat meals by containing it [3]. From the view point of food sources, they are playing as the role of functional foods, which provide health benefit beyond basic nutrition [4]. It is a good source of medicinal food because it contains high level of amino acids and fatty acids. Amino acids might have contributed to its pharmacological properties because the fish include glycine, lysine and arginine, whereas its fatty acids are arachidonic acid, plamitic acid and docosahexaenoic acid [5,6]. Extracts of the fish are produced from whole muscle, skin and mucus of the fish. They appear to effect their influences through the formation of several types of bioactive molecules [4]. *Channa striata* extract could improve the cosmetic appearance of wounds and achieve high patient satisfaction [7].

### Chemistry of Snakehead

The snakehead fish is a useful source of proteins (78.32±0.23%), lipids (2.08±0.08%) and vitamin A (0.265±0.013 mg). It has a high content of arachidonic acid (AA) 20:4ω6 and docosahexaenoic acid (DHA) 22:6ω3. Further, snakehead has contained lipids which are categorized by phospholipid, partial glyceride, cholesterol, fatty alcohol, and triglyceride and cholesterol ester [2,8]. It is known to produce polyunsaturated fatty acids, which regulate prostaglandin synthesis inducing wound healing [11]. The proximate analysis of *C. striata* showed ample amount of crude protein (23%),

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**Figure 1:** Healthy adults of snakehead fish (*Channa striata*).

crude fat (5.7%) and crude ash (1.8%). It is a low-fat fish with an average fat less than 10%. The fatty acid composition indicated the abundant presence of C16:0 fatty acid (30%) along with the other major fatty acids containing C22:6 (15%), C20:4 (19%), C18:1 (12%) and C18:0 (15%). Moreover, the  $\omega$ -3: $\omega$ -6 fatty acid ratio were found to be lower than 1 (i.e., 0.55) and the PUFA/Saturated (P/S) ratio of 0.89 were obtained in the muscle tissue of snakehead [8]. The  $\omega$ -3: $\omega$ -6 ratio has been suggested as reliable indicator for comparing relative nutritional values of fish oils. It was suggested that the ratio of 1:1-1:1.5 constituted a healthy human diet [9].

## Pharmacological Properties of Snakehead

### Skin diseases

South Asian countries have a humid warm tropical weather throughout the year. Most of the peoples are suffering from some sorts of skin diseases, including hormonally balance induced skin problems like acne, pimples, allergy, psoriasis, sclerosis, infection etc. Snakehead is useful in these circumstances and help patients to ease them as well as support for the maintenance of a healthy skin of the human beings. Especially, it's action is due to the presence of docosahexaenoic acid (DHA) 22:6 $\omega$ 3. The essential fatty acid has been fully identified as a nutraceutical with clinical value in the treatment of skin [2,9]. It is recognized that AA metabolism is altered in psoriasis and other skin diseases prompted attempts to inhibit the generation of proinflammatory lipoxygenase products, LT<sub>B4</sub> and 12-hydroxyeicosatetraenoic acid (12-HETE), which are markedly elevated in the psoriatic lesions. Particularly, LT<sub>B4</sub> is related with both the onset and maintenance of chronic topical inflammatory conditions, however, when human ingest fish oil, the EPA and docosahexaenoic acid (DHA) from fish or fish oil lead to modulate prostaglandin metabolism and decrease the symptoms of such disorders [2].

### Wound healing

The essential amino acid and fatty acids of snakehead are the main composition for recovering wound healing in the human body (Figure 2). Wound healing is an extremely complex process involving a series of reactions and interactions among cells and mediators. The skin has a complex tissue that become infiltrated with pro-inflammatory cells during wound repair [12,13]. Snakehead mucus and tissue extracts are found to be contained high amount of amino acids, especially

glycine and arachidonic acid. These two are reported to promote wound healing by initiating collagen synthesis and re-epithelialisation in damaged tissues. Snakehead extracts are recommended for post-operative wound healing as well as post pregnancy rehabilitation and also, it's known to produce polyunsaturated fatty acids, which regulate prostaglandin synthesis including wound healing [11]. The encouraging wound-healing properties of snakehead extracts are sustained by the observation that it is able to affect the tensile strength of the post-operation wound better than established cetrimide cream, including more rapid wound batter contraction and positively influencing the fibroblastic phase of wound healing with a marked increase in glycosaminoglycan. Re-epithelialisation of wound healing is also accelerated under the influences of topical application of snakehead with the benefit of rapid cleansing of wound, thus leaving only minimal scarring [14-16]. Moreover, incorporation of snakehead into palm-oil creams could yield best wound healing results when olefin (DFPL 65) is used as stabilizers [14]. DFPL contains B-carotenes and tocopherols, which also have wound healing properties. Several types of formulations of snakehead aerosol have also been performed and these include aerosol formulations with hydroxyl propyl, methylcellulose as polymer and glycerine as plasticisers, and aerosol formulations incorporated with fluidic acid and a water-based extract [17,18]. The aerosol formulations allow an increased rate of wound healing, while providing more practical effective and safe practical application to incision and burn wounds. Snakehead extracts also have the ability to cause proliferation of mesenchymal cells and maintained sufficient cell viability for use as a biochemical agent and promoter of healing which is not limited to dermal wounds but possibly involving other types of organs too [6].

### Antimicrobial and antifungal properties

Bacteria is one of the major health issues in South Asian countries although plant materials have been the major source of natural therapeutic remedies or used to treat various infectious disease including anti-microbial [2,19,20] but recently snakehead extract had shown positive results as anti-bacterial and anti-fungal agent. As part of the whole healing processes, anti-microbial activity and anti-fungal in particular, is equally important. Snakehead extracts against 13 filamentous fungus and 3 non-filamentous or yeast species has shown inhibition effects. Although the inhibition is not enough to kill the strain, but the partial inhibition by the snakehead extracts will be of a better use for human consumption to avoid unnecessary repercussion [2]. The antimicrobial properties of the skin and intestinal mucus of different snakehead fish showed a broad spectrum of antibacterial activity against *Aeromonas hydrophila*, *Pseudomonas aeruginosa*, *Vibrio anguillarum*, *P. aeruginosa* and *V. fischeri* [21,22]. Anti-fungal activities of snakehead extract have been demonstrated by an ethanol fillet extract against *Neurospora crassa*, *Aleurisma keratinophilum* and *Cordyceps militaris* and also inhibited *Botrytis pyramidal* and *Paecilomyces fumosoroseus* on a short-term basis [21].

### Antinociceptive properties

The anti-nociceptive property and hydromethanolic fraction of snakehead fish is thought to be due to its glycine and arachidonic acid and also produces a dose-dependent anti-nociceptive property, which are known to be involved in the anti-nociceptive pathway with in healing processes [23,24]. The snakehead extract is comparable to morphine in terms of anti-pain or anti-nociceptive properties and actually enhances its effects through a non-opioid mechanism without inducing any addictive behaviour in snakehead models.



**Figure 2:** Fresh water snakehead fish helps in post-surgical wound healing and reduces pain and inflammation.

Heating the mucus extract to high temperatures led to minimal loss in antinociceptive activity; that both extracts maintained their activity within pH range 6.0–8.0 and naloxone pre-treatment had no effect on the activity of either extract. They also stated that lowering the pH of mucus extract to 6.0 did not significantly affect its activity, while raising it to 8.0 attenuated its activity [25]. It would be consistent with a complex, stable macromolecule, most probably a glycoprotein or polypeptide, though we cannot rule out the possibility of a polysaccharide. Biochemical studies will be required to definitively characterise these extracts [26,27].

### Platelet-aggregation

Blood clotting is an important for both diabetic complication and dengue haemorrhagic to stop perfusion of blood that might be fatal and also anaesthesiologists routinely encounter problems with pre-operative evaluation of clot function and management of the pre-operative coagulopathies, especially among major surgical and anaesthetic endeavours such as cardiac, thoracic and vascular procedures. Snakeheads extract not only induce aggregation in normal patients, but more interestingly produced positive results in diabetic patients whom undergone drug treatments, when PAF and Collagen the placebo failed [2]. Snakeheads extracts as agent discovered that the value of Slitting Point (SP), Reaction Time (R), Angle and the TEG Index between treatments (concentration of the extract) was highly significant 2.

### Osteoarthritis treatment

Snakehead was being used by people all over the world for arthritis treatment. Its extract improved the density of PGP 9.5-immunoreactive nerve fibres in the synovial membrane in rat model and proved to be better than the other traditional fish [28]. It also effects of orally administered snakehead fish extract in rabbits experimentally induced osteoarthritis [29]. A significant reduction in soft tissues swelling for treated animals 9 weeks after treatment compared with the untreated group. They revealed that the distribution of PGP 9.5-immunoreactive nerve fibres detected in the sub-intimal layer of the synovial membrane was similar to that detected in the normal synovial membrane, though the density was lower than for normal synovial membrane [30,31].

### Antioxidant properties

Fish is one of the recognised sources of antioxidants and snakehead is one of the prime fresh water fishes to have antioxidant activity, contributed by the amino acids and fatty acids [32,33]. The antioxidants present in Snakeheads are most likely to be lipophilic antioxidants which represent powerful defence tools, particularly against omega-3 oxidation [6]. The amino acids are known to

have significant antioxidant properties as synergists or primary antioxidants and are believed to be important metal chelators with significant potential in linoleic acid and methyl esters of linoleic acid system.

### Craniological effects of snakehead fish

Snakehead is used as a functional food and preventative medicine for hypertensive patients [34]. The skin extract from snakehead fish has been found to contain potent active compound, cardiotoxic factor II (CTF-II)[35], with hypotensive effect and cardiotoxic property that influence the increase in cardiac marker enzyme creatine phosphokinase and creatine phosphokinase-MB values 12 [36]. Snakehead fish oil supplementation is now widely regarded as an effective preventive measure against cardiovascular problems. It could be useful in preventing post-operative atrial fibrillation [37]. Arachidonic acid (19.02%) present in snakehead reduces coronary heart disease considerably. Docosahexaenoic acid and eicosapentaenoic acid exert preventive effects on human coronary artery disease [38]. Epidemiological surveys suggest that fish oil consumption may reduce the risk of fatal ventricular arrhythmias, consistently supporting an anti-arrhythmic effect of PUFAs.

### Neurological effects

The regenerative potential of neurons involved in traumatic injury as observed by neuritis outgrowth and multipolarity of cells, which took place in phaeochromocytoma PC12 cells treated with snakehead therapeutic extract [39]. The various concentration of snakehead fillet extract (30%, 40% and 50% w/v) significantly reduced the immobility time in forced swimming test and tail suspension test [40]. A dose-dependent significant reduction in locomotors activity during open field test and the skin extract of snakehead could initiate apnoea and irreversible blockade of nerve-muscle preparation and influence the serotonergic receptor system [41], as an anti-depressant [42]. Reports on encapsulation of snakehead extract reveal a new medicine in future for treatment of various ailments in one capsule [43]. The skin extract of snakehead could initiate apnoea and irreversible blockade of nerve-muscle preparation [44] and hence, influence the serotonergic receptor system, therefore, it plays possible role as an anti-depressant [42,45]. It is also able to exert positive changes in the regenerative neurons involved in traumatic injury as observed by neuritis outgrowth and multipolarity of cells, which took place in phaeochromocytoma PC12 cells treated with snakehead therapeutic extract [46]. These results exposed the possibility of using snakehead extract as a regenerative and restorative agent for treating damages caused in many types of tissues and organs.

### Anti-Inflammatory and antipyretic

Certain the possible anti-inflammatory property of *C. striata* extract, its use in treating diseases with an inflammatory component has been explored in the amelioration of osteoarthritis [30,31,47]. The anti-inflammatory effect of snakehead extracts in both acute and chronic inflammation appears to be better than that of other channidae [48,49]. There have been substantial reports explaining reduction of soft tissue swelling and synovial inflammation and significant improvement in the density of PGP 9.5-immunoreactive nerve fibres in the synovial membrane of the osteoarthritis joints in rats. It plays a significant role in the treatment of joint diseases with a clearer inflammatory component such as rheumatoid arthritis. The anti-inflammatory property may also be the reason behind the observable antipyretic activity of the aqueous extract [50].

## Conclusion

Snakehead is a reputed medicinal fresh water fish among the South Asian regions and used to treat wounds, alleviate pain, boosts energy and endowed with remarkable anti-inflammatory, anti-nociceptive, platelet aggregation, as well as mild antimicrobial and antifungal properties. It's nutraceutical value is outstanding and essentially contributes, at least in part, to the bioactive compounds, engaging in clinical trials, therapeutics and nutritional supplements. Snakehead extract may also have a role in other non-traditional uses such as in treating neurological diseases and in inducing regenerative potential of organs and cells. Therefore, snakehead fish has a high potential to be used as a promising acceptable source of medicines and nutrients for the treatment of serious diseases as well as for the improvement of general body tones of human beings to a greater extent.

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