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Studies of kidney biochemistry of Channa punctatus (bloch.) After treating with carbofuran

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Abstract

Pesticides are one of the most efficient weapons developed by man to defend agricultural goods from insect assault. However, the widespread use of pesticides poses a persistent danger to aquatic life by affecting habitat behaviour, growth, and reproductive capacity. Despite significant research activity in the area of pesticides, the quantity of knowledge accessible on the impact of certain pesticides on chosen non-target species varies greatly. Fishes have received the most attention among the creatures investigated owing to their economic value. The goal of this research is to look at the hazardous effects of the pesticide carbofuran on the fish Channa punctatus. The study will be carried out in kidney biochemical observation. The parameter selected includes - urea, uric acid calcium, potassium, sodium, creatinine so with the help of the parameters can results in serious outcomes in various diseases in fishes. Keywords - urea, uric acid, calcium, potassium, sodium, creatinine, *Channa punctatus*

Introduction

Aquatic systems have gained prominence as a result of increased concern about the consequences of human population growth and activities on aquatic life and water quality. Water contamination is a big issue on a worldwide scale. It has been stated that it is the main cause of mortality and illness on a global scale, responsible for the deaths of thousands of people every day. Water is often considered polluted when it is contaminated by anthropogenic pollutants and either becomes unfit for human use, such as drinking water, or exhibits a dramatic decline in its capacity to maintain its component biotic populations, such as fish. Numerous pesticides are also a cause of water pollution in agriculture, since they are sprayed on crops to protect them from pests and insects. They have an effect on the soil's structure and fertility. These pesticides enter aquatic bodies such as rivers, ponds, the ocean, and lakes through runoff. Pesticides are chemical agents used to eradicate pests. A pesticide is, in general, a chemical or biological agent. Pesticides are a class of hazardous substances that are connected to human usage and have a significant impact on aquatic life and water quality. Pesticides are one of the most efficient weapons mankind has devised for defending agricultural goods from insect assault. However, widespread pesticide usage poses a persistent danger to aquatic life by modifying the habitat's behaviour pattern, development rate, and reproductive capacity. While significant research is being conducted in the subject of pesticides, there is great diversity in the quantity of knowledge available on the impact of certain pesticides on chosen non-target species. Fishes have received the most attention of all the creatures investigated, owing to their economic value. Contaminants that enter the body of an organism by absorption or other means penetrate deeply into the tissues, affecting the organism's physiology, biochemistry, and metabolism. Numerous fertilisers and insecticides with varying chemical compositions have been used to accomplish this goal, all of which have direct or indirect deadly effects on a variety of species (Singh et al. 2010). Pesticides are known to create major environmental (3) problems during the dry season, since the diluting capacity of the water system is reduced, raising the possibility of harmful chemical concentrations. Population growth, industry, urbanisation, and agricultural activities have all contributed to water contamination, which has become a serious worry for mankind (Edori et al. 2013a). Steps have been done in the lake to monitor the quantity of pesticides and other contaminants in water samples. Pollution monitoring has been conducted in the lake. Several national drinking water missions and an integrated programme on pesticides and other pollutants have determined that the majority of the lake's locations are badly contaminated by industrial effluents, which are liquid waste products from industrial activity. They are emitted by a variety of industrial processes, including petrochemical complexes, fertiliser plants, oil refineries, pulp and paper mills, textile mills, sugar mills, steel mills, and tanneries. All chemical and industrial wastes are hazardous to animals, and several reports of fish mortality or sub-lethal kidney disease have been made. Carbofuran is a pesticide sold under the brand name Furadan by the FMC Corporation of Philadelphia. It is used to manage insects in a broad range of field crops, including potatoes, maize, and (4) soybeans. The roots of the plants absorb it, and insecticidal concentrations are maintained throughout. Carbofuran is one of the most harmful pesticides used on field crops due to its high acute toxicity. A quarter teaspoon of carbofuran is lethal to humans, and aquatic creatures are very harmful to fish.

Materials and Methods

The test animal was Channa punctatus (Bloch.). It has an elongated body with a large head and a tapering tail. It is often seen in fresh water. It is a tough fish that adapts well to aquarium conditions. The fish were taken between September and October, when the ambient temperature ranged between 250 and 300 degrees Celsius. Adult live Channa punctatus (Bloch.) specimens ranging in size from 16-18 cm and weighing 40–70 g were acquired from a local market. They were examined thoroughly for signs of damage and then placed in a 0.2 percent KMnO4 solution for a few minutes to clear any skin infection. Finally, they were housed for 15 days in a big glass tank under laboratory conditions. Every other day, dechlorinated water is utilised and replaced. Numerous physiochemical properties (16) of test water were routinely recorded, including temperature, pH, and hardness. Carbofuran, an anticholinesterase carbamate, is widely used in agricultural practise around the globe as an insecticide, nematicide, and acaricide. As a result of its ubiquitous use in (17) agriculture, contamination of food, water, and air has become a certainty, and as a result, ill health impacts on people, animals, wildlife, and fish are unavoidable. At the moment, carbofuran is most often used in malicious poisoning. A short assessment of the literature on carbofuran's chemical characteristics, acute toxicity data, poisoning occurrences, pharmacokinetics, and mechanism of toxicity is presented. The metabolism of carbofuran and its two main metabolites (3-hydroxycarbofuran and 3-ketocarbofuran) are discussed extensively, as is the effect of carbofuran and its two major metabolites on overall toxicity. Carbofuran's biochemical (cholinergic and noncholinergic), haematological, and immunological effects are extensively explored. Carbofuran and/or its main metabolites have the potential to breach the placental barrier, posing substantial risks to the maternal-placental-fetal unit. Simultaneous exposure to other cholinesterase inhibitors may exacerbate carbofuran's toxicity. Additionally, the literature is reviewed for several indicators of carbofuran exposure and for caused adverse health consequences. To date, the most effective antidote against acute carbofuran poisoning is a combination of atropine and memantine. Five aquariums were employed in the experiment; one was used as a control, while the other four were used to research pollution. Each tank includes ten fish that were exposed to a sublethal dose (19) of Carbofuran throughout a 24-hour period (24, 48, 72 and 96 hour). Sublethal concentrations were chosen based on the LC5o value.

SERUM SEPARATION

Blood samples were allowed to coagulate for about one hour before being centrifuged at 2000 rpm for 15 minutes. The supernatant serum was separated using a tiny rubber bulb pipette. The serum was analysed for urea, uric acid, creatinine, sodium, potassium, and calcium ions.

UREA SERUM

The serum urea concentration was determined using the GLDH-Urase technique, as reported by Young (1990).

URIC ACID IN SERUM

The serum uric acid concentration was determined using a modified phosphotungstate end point test (1989)

CREATININE LEVELS IN SERUM

The serum creatinine concentration was determined using the alkaline picrate technique established by Toro and Ackermann (1975).

SODIUM AND POTASSIUM SERUM

The electrolytes in serum were determined using an ion selective electrode technique and an analyser (Perkin and Almer).

CALCIUM SERUM (Ca++)

Trinder's technique was used to determine the serum calcium (Ca++) ion concentration (1960).

Result and Discussion

For 24 hours, Channa punctatus serum urea concentration was 35.800.25 mg/dl, 39.990.12 mg/dl for 48 hours, 45.500.33 mg/dl for 72 hours, and 49.880.30 mg/dl for 96 hours, respectively. The serum urea level increases in response to therapy. After 24 and 48 hours of repeated carbofuran administration, the rise in serum urea was non-significant, but substantial after 72 hours and very highly significant after 96 hours. For 24 hours, Channa punctatus had a serum uric acid concentration of 23.600.27 mg/dl, 28.330.27 mg/dl for 48 hours, 33.100.19 mg/dl for 72 hours, and 39.500.22 mg/dl for 96 hours, respectively. The serum uric acid level increases in response to therapy. After 24 and 48 hours of repeated carbofuran administration, the rise in serum uric acid was not significant, but was substantial after 72 hours and very highly significant after 96 hours. Channa punctatus serum creatinine levels were 1.180.04 mg/dl for 24 hours, 1.2530.06 mg/dl for 48 hours, 1.310.05 mg/dl for 72 hours, and 1.390.03 mg/dl for 96 hours, respectively. The serum creatinine level increases in response to therapy. After 24 and 48 hours of repeated carbofuran administration, the rise in serum creatinine was not significant, but was significant after 72 hours and very highly significant after 96 hours. For 24 hours, the serum sodium concentration in Channa punctatus was 126.520.40 mmol/l, 119.330.67 mmol/l, 110.500.35 mmol/l for 72 hours, and 102.550.66 mmol/l for 96 (39) hours, respectively. Serum sodium levels decrease as a result of therapy. After 24 and 48 hours of repeated carbofuran administration, the reduction in serum sodium was not significant, but was significant after 72 hours and very highly significant after 96 hours. The serum potassium concentration in Channa punctatus was 5.500.33 mmol/l after 24 hours, 5.920.20 mmol/l after 48 hours, 5.990.14 mmol/l after 72 hours, and 6.200.18 mmol/l after 96 hours. The serum potassium level increases in response to therapy. After 24 and 48 hours of repeated carbofuran administration, the rise in serum potassium was not significant, but was substantial after 72 hours and very highly significant after 96 hours (Table-VI). For 24 hours, the serum calcium concentration in Channa punctatus was 4.330.25 mg/dl, 4.050.28 mg/dl for 48 hours, 3.880.30 mg/dl for 72 hours, and 3.250.19 mg/dl for 96 hours, respectively. Serum calcium levels decrease as a result of therapy. After 24 and 48 hours of repeated carbofuran administration, the reduction in serum calcium was not significant, but was significant after 72 hours and very highly significant after 96 hours. Urea is classified as a nitrogenous non-protein waste (NPW). It is the major product of protein metabolism and is eliminated by the kidneys; its content is proportional to protein absorption. Serum creatinine, on the other hand, is an NPN waste product formed during the breakdown of creatine and phosphocreatine. It is less diet-dependent and is thus an excellent indication of renal function (Jyothi and Narayan, 2000). The current research found that serum urea and creatinine concentrations in Channa punctatus were raised at various time intervals of 24, 48, 72, and 96 hours in comparison to the control group, indicating compromised kidney function owing to carbofuran poisoning. Renal failure associated with severe renal insufficiency or excessive protein breakdown as a result of toxic stress may be responsible for blood urea and creatinine elevations (Jyothi and Narayan, 2000). Similar to the current results, Venkataraman et al. (2005) reported a rise in urea in blood serum when malathion and a higher temperature were combined, suggesting a successful conversion of hazardous ammonia to non-toxic urea and an increase in urea in blood serum. While Khaled et al. (2015) noted that an increase in creatinine concentration beyond normal levels is considered a sign of renal impairment after profenofos poisoning in Nile tilapia. According to Thoker et al. (2016), the rise in urea and creatinine concentrations in the blood serum of Channa punctatus (Bloch.) after malathion poisoning might be a result of renal impairment. According to Gautam et al. (2014), the rise in serum urea content in Channa punctatus indicates that the kidney's glomerular filtration rate (GFR) is insufficient after the harmful impact of Nuvan (organophosphate) on Clarias batrachus. Deka and Mahanta (2015) observed that catfish Heteropneustes fossilis (Bloch.) grown in water treated with the organophosphate insecticide dichlorvus create much more urea than ammonia through the ornithine cycle. Channa punctatus has a rise in serum uric acid and creatinine concentrations. Abdelmeguid et al. (2002) demonstrated a substantial rise in serum creatinine concentrations in fish taken in significantly and moderately polluted regions compared to fish farm areas. Similarly, Priya et al. (2012) found that serum creatinine levels increased marginally in the experimental group compared to control mice, and that the rise was associated with renal failure. Additionally, Attia and El-Badawi (45) (2015) showed a substantial rise in creatinine levels with increasing dithiopyr exposure period. Sodium ions are the predominant cation in blood plasma and are involved in maintaining acid-base balance; they also help maintain the concentration of the heart and involuntary muscles and stimulate neurons (Pohl et al. 2013). In this research, sodium ions were shown to decrease in the serum of Channa punctatus at various time intervals of 24, 48, 72, and 96 hours as compared to the control group exposed to carbofuran toxicity. The current research observed a decrease in sodium ions as a result of carbofuran toxicant interfering with normal organ activities, resulting in the failure of the osmoregulation process in fish. C. punctatus demonstrated a substantial rise in creatinine and uric acid concentrations with increasing exposure duration in both acute and chronic experiments when compared to the control group; these findings were consistent with those of several authors (El-Amin, 2002; Fouda, 2004). Because creatinine excretion is almost entirely dependent on the process of glomerular filtration, a significant increase in serum creatinine levels may be due to impaired glomerular function, tubular damage in the kidney (Mansour and Mossa, 2010), or to the effect of oxygen deficiency on the glomerular filtration rate, resulting in pathological changes in the kidneys (Shalaby et al., 2005). C. punctatus demonstrated a substantial rise in creatinine and uric acid concentrations with increasing exposure duration in both acute and chronic experiments when compared to the control group; these findings were consistent with those of several authors (El-Amin, 2002; Fouda, 2004). 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Additionally, hypocalcemia has been seen in teleosts exposed to carbofuran, deltamethrin, Metacid-50, and chlorpyrifos (Mishra et al., 2001, 2004, 2005; Atamanalp et al., 2002; Logaswamy et al., 2007). When Oreochromis mossambicus was subjected to dimecron and ziram, Thangavel et al. (2005) observed hypocalcaemia and hypophosphataemia. Previously published research indicates that the hypocalcemic impact is produced by reduction of Ca^{+2} absorption by the gills. Pesticide-exposed fish often exhibit gill epithelial damage (Yildirim et al., 2006; Velmurugan et al., 2007; Peebua et al., 2008). The injury to the branchial epithelium most likely restricts the intake of Ca^{+2} from the ambient water, leading in hypocalcaemia in H. fossilis, which manifests as respiratory distress, hyperexcitability, and tremor. Carbofuran exposure resulted in significant abnormalities in the kidney, which began with tubular organisation disturbance.

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