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Effect of *Nephelium lappaceum* Fruit Flesh on Acute Toxicity and Behavioural Responses of *Catla catla* (Hamilton, 1822) Fingerlings

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Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

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ABSTRACT

Nephelium lappaceum, popularly known as 'Rambutan', is an evergreen tree. This plant has been used as traditional medicine, and the fruits have always remained a potential source of nutrients. The acute toxicity data has been used to derive water and feed quality guidelines for regulatory measures in experiments. The aim of the present study is to determine the effect of Nephelium lappaceum fruit flesh on acute toxicity and behavioural responses of Catla catla fingerlings. The experimental fish species of Catla catla fingerlings showed acute exposure to Nephelium lappaceum fruit crude powder caused significant non-sensitivity to all concentrations (250, 500,

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1000, 2000 and 4000 mg/kg), and the mortality rate was nil. The juvenile *Catla catla* exposed to various lethal concentrations of *Nephelium lappaceum* fruit flesh crude powder exhibited normal behavioural responses. Present results finding *Nephelium lappaceum* fruit flesh crude powder was non-toxic were observed in supplementation to *Catla catla* fingerlings, based on a maximum concentration of 4000 mg/kg, while it may promote health benefits. This study provided evidence that *Nephelium lappaceum* fruit was non-toxic, which is classified as practically non-toxic and promotes its consumption by aquatic organisms.

Keywords: Nephelium lappaceum; acute toxicity; LD50; Catla catla.

1. INTRODUCTION

"Acute toxicity testing involves the estimation of LC_{50} or LD_{50} , which is the concentration or dose that proved to be lethal, causing mortality in 50% of the tested organisms" [1,2]. "The types of toxicity tests that are routinely performed by pharmaceutical manufacturers in the investigation of a new drug involve acute, subacute, and chronic toxicity" [1]. "Probit analysis is a specialised regression model for binomial response variables. It is used to analyse many kinds of dose-response experiments in a variety of fields. Probit analysis is commonly used in toxicology to determine the relative toxicity of chemicals and natural products, such as plant and animal secondary metabolites to living organisms. Fish is a very important dietary animal protein source in human nutrition. Production of aquatic species through freshwater fisheries and aquaculture for protein supply is encouraged in developed and developing countries. Since the science of toxicology began thousands of years ago, behavioural endpoints have been used to study the effects of chemicals and drugs on humans and other mammals. In aquatic toxicology, however, the nexus of behavioural sciences with the study of toxicants has only become prominent within the last 5 decades", according to Gruber et al. [3]. Management measures aimed at conserving freshwater fish should be part of fishery policies.

"Nephelium lappaceum L. (Family: Sapindaceae), popularly known as 'Rambutan', is an evergreen tree about 10-12 m tall with greyish brown branches" [4]. "The tree is native to Malaysia but is grown in other parts of the world" [5]. "Nephelium lappaceum fruit residuals such as the peel and seeds hold greater nutraceutical potential than the edible part, and fruits contain a diverse and important chemical profile that can alleviate or cure diseases" [6]. "Rambutan is a fruit with a perplexing, sweet flavour and contains an astonishing range of bioactive chemicals, while other health benefits focus antioxidant, antimicrobial, on

antidiabetogenic, anti-obesogenic, other health benefits, and toxicological properties" [7]. Hernández-Hernández et al, [8] summaries "information about the bioactive compounds present in the rambutan fruit, together with the nutritional properties that it presents as a functional food. However, it suggested the nutritional and functional potential of this fruit, the therapeutic mechanisms involved, and the need to develop its industrial process as a functional or nutraceutical food product. The aim of the present study is to determine the toxicity level of *Nephelium lappaceum* fruit using exposed juvenile *Catla catla* freshwater fish".

2. MATERIALS AND METHODS

2.1 Plant Materials

Nephelium lappaceum fruits were purchased in Nilgiris fruit shop, Thanjavur, Tamil Nadu. The collected fruits were washed in water, cleaned well to remove all traces of insects, dust and other kinds of pollution. Peel off the skin of the Nephelium lappaceum fruit and collected the white flesh after removing the seed. The collected flesh was used in the subsequent experiments.

2.2 Preparation of *Nephelium lappaceum* Fruits Crude Powder

The fruit flesh of *Nephelium lappaceum* was first washed several times with distilled water and traces of impurities were removed from the flesh. Healthy flesh was spread out in plain sheet and dried in shade at room temperature (37°C) for about 10 days. The collected flesh was crushed into tiny pieces and makes a fine powder using a grinder mixture. The crude powder was subjected to analysis the acute-lethal toxicity.

2.3 Preparation of Floating Pellet in Acute Toxicity

The Nephelium lappaceum fruit flesh crude powder were heated to about 50°C and then

cooled to room temperature (37°C). These were then put to hand Murukku Maker (Alternative to pelletizer fitted) with a 2.0 mm diet [9]. The experimental fish were fed once at a fixed feeding range of 250, 500, 1000, 2000 and 4000 mg/kg for a period of the experiment and monitor for 96 hours.

2.4 Acute-lethal Toxicity Study [10]

"Range finding concentrations of 250, 500, 1000, 2000 and 4000 mg/kg were obtained using ten fish as test animals and replicated thrice to determine the acute-lethal concentrations. Ten healthy juveniles of Catla catla in both sexes, were selected for the acute-lethal toxicity test which lasted for 96 hours. The iuveniles were of length 5.35±0.16 cm and weight 7.80±0.14g, while those used for the range finding toxicity test for 96-h. Fish mortality and behaviour were monitored and recorded prior death" "The to [11]. experiment was conducted using a complete randomized comprising design (CRD), treatments with replicates. of six three Mortality data were analysed using SPSS software. while LC_{50} was calculated logarithmically" [12].

3. RESULTS AND DISCUSSION

Fish exposed to different concentrations of *Nephelium lappaceum* fruit crude powder on juvenile *Catla catla* fish. Fish mortality and behaviour were monitored for 24 to 96 hours. "Acute toxicity data has been used to derive water and feed quality guidelines for regulatory measures" [13]. In the present study, fish species of *Catla catla* fingerlings showed acute exposure to *Nephelium lappaceum* fruit crude powder

caused significant non-sensitivity to all concentrations, and the mortality rate was nil, as represented in Table 1. The assessment of acute toxicity by bioassay can prove the safety of Nephelium lappaceum fruit and promote its consumption by aquatic organisms. Several studies have revealed that the many plant extracts become toxic to the different organs in a concentration-dependent manner lethality. and can lead to Xavier and Reddy [14] agreed that "some herbal products that are used as remedies for different diseases are not undertaken because of their toxicity level".

"Behaviour provides a unique perspective linking the physiology and ecology of an organism and its environment" [15]. "Behaviour is both a sequence of quantifiable actions operating through the central and peripheral nervous systems [16] and the cumulative manifestation of genetic, biochemical, and physiologic processes essential to life such as feeding, reproduction, and predator avoidance". "Selective evolutionary processes have conserved stable behavioural patterns in concert with morphologic and physiologic adaptations. This stability provides the best opportunity for survival and reproductive success by enabling organisms to efficiently exploit resources and define suitable habitats" [15]. The Nephelium lappaceum fruit crude powder supplementation of Catla catla showed that all fish were no morphologically and physically changes. Their swimming movement, gulping for air, body colour, eyes, and fins were normal. No mucus secretion or mortality was observed (Tables 2a and b). The juvenile Catla catla exposed to various lethal concentrations of Nephelium lappaceum fruit crude powder exhibited normal behavioural responses.

Table 1. Determination of lethal concentration of Nephelium lappaceum fruit crude powder

Concentration (mg/kg)	Total exposed fish	Mortality (hours)						
		24	48	72	96			
250	10	Nil	Nil	Nil	Nil			
500	10	Nil	Nil	Nil	Nil			
1000	10	Nil	Nil	Nil	Nil			
2000	10	Nil	Nil	Nil	Nil			
4000	10	Nil	Nil	Nil	Nil			
Control	10	Nil	Nil	Nil	Nil			

Table 2a. Behavioural responses exposure time 24 and 48 hrs of Nephelium lappaceum fruit crude powder supplementation to Catla catla fingerlings

Control	Concentration (mg/kg)									
	250		500		1000		2000		4000	
	24h	48h	24h	48h	24h	48h	24h	48h	24h	48h
+	+	+	+	+	+	+	+	+	+	+
-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-
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 Table 2b. Behavioural responses exposure time 72 and 96 hrs of Nephelium lappaceum fruit crude powder supplementation to Catla catla fingerlings

Behaviours	Control	Concentration (mg/kg)									
		250		500		1000		2000		4000	
		72h	96h	72h	96h	72h	96h	72h	96h	72h	96h
Fish active	+	+	+	+	+	+	+	+	+	+	+
Loss of reflex	-	-	-	-	-	-	-	-	-	-	-
Air gulping	-	-	-	-	-	-	-	-	-	-	-
Erratic swimming	-	-	-	-	-	-	-	-	-	-	-
Mucus secretion	-	-	-	-	-	-	-	-	-	-	-
Loss of scale	-	-	-	-	-	-	-	-	-	-	-
Haemorrhage	-	-	-	-	-	-	-	-	-	-	-
(+ = Present - = Absent)											

Mahmood et al. [17] studied "functional foods and herbal medicine using rambutan fruit (Nephelium lappaceum L.), which appears to be a promising candidate primarily due to its nutritional and bioactive compositions while also being a sustainable candidate for developing functional pharmaceuticals". foods and "Nephelium lappaceum, popularly known as 'Rambutan', is an evergreen tree, native to Malaysia but is grown in other parts of the world. This plant has been used as traditional medicine, while the fruits have always remained a potential source of minerals and other nutrients" [4]. Present results finding Nephelium lappaceum fruit crude powder was non-toxic were observed in supplementation to Catla catla fingerlings, based on a maximum concentration of 4000 mg/kg, while it may promote health benefits. "N. lappaceum has a long history of human use and is considered safe with no information on toxicity. Studies on acute toxicity and liver function effects of crude extract from the fruit rind of rambutan in rats revealed no toxicity at doses up to 5 g/kg" [4]; our study similarly found a maximum dose of 4 g/kg with no toxicity. Another study of the acute

and sub-chronic toxicity of the ethanol extract of rambutan rind was assessed in rats. The extract was administered orally at 50, 200, 1000, or 2000 mg/kg as a single dose for 14 days, and at 500 and 2000 mg/kg, sub-chronic toxicity studies were performed for 28 days. The present study agreement with Thinkratok et al. [18] who reported "the acute and sub-chronic toxicity studies of the hydroethanolic extract of Rambutan rind revealed that LD₅₀ was greater than 5000 mg/kg, p.o. which revealed no mortality or any sign of adverse effects in rats". Another study by Rajasekaran et al. [19] reported "the acute toxicity of the methanol extract of Rambutan seeds (Raw, Boiled and Roasted) and concluded that all three extracts were safe up to 3000 mg/kg dose".

4. CONCLUSION

The results of exposure to *Nephelium lappaceum* fruit flesh crude powder provided the lethal dose (LD_{50}) for *Catla catla* fingerlings, which is classified as practically non-toxic upto 4000mg/kg. This study provided evidence that

Nephelium lappaceum fruit fleshwas non-toxic and promote its consumption by aquatic organisms.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

- 1. Okomoda V, Solomon SG, Ataguba GA, Ayuba VO, Asuwaju FP. Acute toxicity test in aquaculture. A Review. 2013;171-175.
- 2. Velavan S, Shunmuga Vadivu R. Acute and subacute toxicity of ethanol extract of *Caralluma indica* stem on haematological, biochemical and histology of the liver in rats. World Journal of Science and Research. 2020;5(2):01-11
- Gruber J. Kikuchi T, Ichimura K. The incidence of mandated maternity benefits. The American Economic Review. 1994;622-641.
- Sukmandari NS, Dash GK, Jusof WHW, Hanafi M. A Review on Nephelium lappaceum L. Research Journal of Pharmacy and Technology. 2017;10(8): 2819-2822.
- 5. Blancke R. Tropical fruits and other edible plants of the world: An illustrated guide. Ithaca, New York. Comstock Publishing Associates. 2016;164.
- 6. Tsong JL, Goh LPW, Gansau JA, How SE. Review of *Nephelium lappaceum* and *Nephelium ramboutan-ake* a high potential supplement. Molecules. 2021;26(22):7005.
- 7. Gursimran Kaur, Muskaan, Nitish Chaudhary, Zorempuii. A review paper on rambutan. The Pharma Innovation Journal. 2022;11(1):1052-1060.
- Hernández-Hernández C, Aguilar CN, Rodríguez-Herrera R, Flores-Gallegos AC, Morlett-Chávez J, Govea-Salas M, Ascacio-Valdés JA. Rambutan (*Nephelium lappaceum* L.): Nutritional and functional properties. Trends in Food Science & Technology. 2019;85:201-210.
- 9. Kalita P, Mukhopadhyay PK, Mukherjee AK. Supplementation of four nonconventional aquatic weeds to the basal diet of *Catla catla* and *Cirrhinus mrigala* fingerlings: Effect on growth, protein utilization and body composition of fish.

Acta Ichthyologica et Piscatoria. 2008; 38(1):21-27.

- Adesina BT, Omitoyin BO, Ajani EK, Adesina OA. Acute-lethal toxicity (LC₅₀) effect of *Moringa oleifera* (Lam.) fresh root bark extract on *Oreochromis niloticus* juveniles under renewal toxicity exposure. International Journal of Applied Agriculture and Apiculture Research. 2013;9(1-2):182-188.
- 11. Fafioye OO. Acute and sub-acute toxicities of five plant extracts on white tilapia, *Oreochromis niloticus* (Trewavas). Irjas. 2012;2(13):525-530.
- 12. Steel RG, Torrie JH, Dickey DA. Principles and procedures of statistics: A Biometrical Approach. Mc Grawhill Singapore.1997.
- Sunderam RIM, Thompson GB, Chapman J C, Cheng DMH. Acute and chronic toxicity of endosulfan to two Australian Cladocerans and their applicability in deriving water quality criteria. Archives of Environmental Contamination and Toxicology. 1994;27:541-545.
- 14. Xavier J, Reddy J. Acute toxicity study of ethanolic extracts of leaf and fruit of two different varieties of *M. Charantia* in *Danio rerio.* Journal of Pharmaceutical, Chemical and Biological Sciences. 2019;7(2): 102–109.
- Little EE, Brewer SK. Neurobehavioral toxicity in fish. Target organ toxicity in marine and freshwater teleosts. 2001;141-176.
- Keenleyside Miles HA. Diversity and adaptation in fish behavior. In Zoophisiology 1979;1:1–16.
- Mahmood K, Kamilah H, Alias AK, Ariffin F. Nutritional and therapeutic potentials of rambutan fruit (*Nephelium lappaceum* L.) and the by-products: a review. Journal of Food Measurement and Characterization. 2018;12:1556-1571.
- Thinkratok A, Suwannaprapha P, Srisawat R. Safety assessment of hydroethanolic Rambutan rind extract. Acute and subchronic toxicity studies. Indian J. Exp. Biol. 2014;52:989-995.
- Rajasekaran A, Ganesan S, Kamini N, Lavanya C, Yoon LL and Oh HS. Antinociceptive, CNS, antibacterial and antifungal activities of methanol seed extracts of *Nephelium lappaceum*. Orient Pharm. Exp. Med. 2013;13(2):149-157.

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