Preparation of Karkataka Taila, an Edible crab Rasayana, and assessment of its toxicological effects on SH-SY5Y cell line and on Drosophila melanogaster embryos

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ABSTRACT
Background: Karkataka Taila (KT) is a virgin coconut oil (VCO) based Rasayana formulation that is enriched with the flesh of freshwater edible crab, Scylla serrata, used to treat Parkinson’s Disease (PD) or Kampavata by local Ayurveda practitioners of Kerala state. There is no scientific study carried out on its toxicological effects so far. Objective: To understand the ayurvedic preparation method for KT and assessment of the toxicological effects of the KT and VCO on SH-SY5Y cell lines and Drosophila melanogaster embryos. Materials and methods: The SH-SY5Y cell lines treated with different concentrations of KT and VCO range from 6.25 µg/ml to 100 µg/ml and Drosophila melanogaster embryos fed with food containing different concentrations of KT and VCO, ranging from 0.005 % to 10 %. Results: KT and VCO did not show any significant cytotoxicity effect on SH-SY5Y cell lines and D. melanogaster embryos. KT has shown a cytotoxic effect and it was higher than the VCO. Conclusions: Our findings revealed that as the concentration of Rasayana in the medium increases, there is a noticeable adverse effect on the percentage viability in SH-SY5Y cell lines and in the number of offspring in Drosophila. The effect of vehicle, VCO, at the same concentration has shown a protective effect on cell lines and flies. It can be concluded that the toxic effect has been observed only at higher concentrations of KT and at the lower concentration, the toxic effect has been minimal.

Key words: Drosophila melanogaster, SH-SY5Y, Rasayana, Toxicology, Virgin coconut oil.

INTRODUCTION
Ayurveda is the science of life or an art of living and it is the most indigenous system of medicine in India, and it is being practiced for over 6000 years.1 The primary goal of Ayurveda is to maintain good health and disease prevention through the treatment regimen.2 In the last decade, there was a significant shift towards the AYUSH system of medicines viz., Ayurveda, Yoga, Unani, Siddha, and Homeopathy from the modern system of medicine.3 In 2021, during the COVID-19 pandemic, to treat and prevent, the physicians recommended the use of immunomodulatory agents from AYUSH medicines, maybe containing a single or polyherbal formulations like AYUSH-64 from Ayurveda,4 Arsenic album from Homeopathy,5 and Kabasura Kudineer from Siddha.6 In Ayurveda, Rasayana or rejuvenating therapy is one of the unique branches and is believed to be useful to overcome challenging diseases in the modern era. According to Charaka, the father of Ayurveda, Rasayana is a method of obtaining the best qualities of various dhatu (tissues). Susruta mentions that Rasayanas are capable of pacifying all afflictions.7 It ensures appropriate nourishment, growth, and increased function of all dhatu. Also, it has an impact on both the body and the mind at one single time, reducing the effects of early aging on both and improving the body’s illness resistance.8 In Ayurveda, regular consumption of Rasayana is believed to improve memory, learning ability, and concentration. The Rasayana drugs are reported to act as an antioxidant, anti-inflammatory, neuroprotective, immunostimulant, and adaptogenic.9 Crabs are the most common macrofauna in coastal areas, and are found in variety of species and even groups. Some of these crabs have poisons in the form of specific protein compounds.10 India has approximately 96 species of freshwater crabs out of 1476 species throughout the world.11 Scylla serrata Forskal is an edible freshwater crab in the Portunidae family. It is spread evenly throughout the mangrove forest regions of the Indo-West-Pacific.12 It is rich in proteins, carbohydrates, minerals, fatty acids, and vitamins.13-16 Traditionally it is used by the tribes of Sundarban, West Bengal state in India, to cure pulmonary tuberculosis, urticaria, skin burns, dropsy, body swelling, bone fracture, asthma, insomnia, rickets, measles, epilepsy, and diabetes.17-20 The Ayurvedic preparation of crab by name, Karkataka (crab) Taila (oil) is found to be effective internally and externally in the treatment of knee joint ligament injury.21 Karkataka Bhasma is traditionally used to treat constipation, headache, chronic cough, tuberculosis, and neurological disorders. The Scylla serrata flesh has been used in...
Ayurveda, Siddha, and Unani system of medicine for alleviating Vata dosha and treating neurological disorders.22

Parkinson's disease (PD) in Ayurveda is known as "Kampavata" (Kampa meaning shaking or tremor and Vata is one of the three humors of the body). All the motor and sensory functions in the body are governed by Vata. Major neurological problems come under 'Vata Vyadhis' and Kampavata is one among them. Ayurvedic literature mentions related symptoms, such as rigidity (sthambha), bradykinesia (chestasanga), flexed posture (avanama), gait abnormalities (gatisanga), monotonous speech (vakvakriti), depression (vishada), impairment in memory (smritihani), and constipation (vibandha) also under Kampavata.23 One of the Ayurveda treaties, namely, "Basavarajeeyam" explained the Kampavata.24 Galen is credited with coining the term "shaking palsy" in the Western medical literature (129–200), later 1817 by Dr. James Parkinson's disease (PD) in Ayurveda is known as "Kampavata" (Kampa meaning shaking or tremor and Vata is one of the three humors of the body). All the motor and sensory functions in the body are governed by Vata. Major neurological problems come under 'Vata Vyadhis' and Kampavata is one among them. Ayurvedic literature mentions related symptoms, such as rigidity (sthambha), bradykinesia (chestasanga), flexed posture (avanama), gait abnormalities (gatisanga), monotonous speech (vakvakriti), depression (vishada), impairment in memory (smritihani), and constipation (vibandha) also under Kampavata.23 One of the Ayurveda treaties, namely, "Basavarajeeyam" explained the Kampavata.24 Galen is credited with coining the term "shaking palsy" in the Western medical literature (129–200), later 1817 by Dr. James Parkinson.

Preparation of Karkataka Taila and VCO by the traditional method

Edible crab Rasayana was prepared by the traditional method and the process was known as Sneha Kalpana. In Sanskrit, Sneha means oil, and Kalpana means pharmaceutical process (Figure 1). Here, 1 part of Kalka (crab flesh), 4 parts of Sneha (coconut milk), and 16 parts of Dravya (water) were mixed. Coconut milk was prepared by grating the coconut and grinding it mechanically with water. All three ingredients were mixed and boiled in a bronze vessel. The consistency of formulation is very significant in this preparation. First, the consistency would be in the mud stage, then the wax stage, and finally in the sand stage. At the sand stage, the formulation was removed from the fire and filtered immediately to obtain Rasayana. The same procedure was used to prepare VCO without crab flesh (Figure 2).

Qualitative zoochemical analysis of Karkataka Taila and VCO

Rasayana prepared was subjected to qualitative chemical tests for the identification of the nature of zoocorpuscular present. For the identification of carbohydrates (Molisch test, Fehling test, Barfoed's test, Benedict test, and iodine test), proteins (Biuret test, Xanthoprotein test, and lead acetate test), amino acids (Ninhydrin and Millions test), steroids (Salkowski reaction and Liebermann-Burchard reaction), flavonoids (Shinoda test and alkaline reagent test), saponins (froth test), phenols (ferric chloride test), fats and oils (translucent spot test) chemical tests were carried out on KT and VCO.25 26

Physicochemical characterization

Morphological and elemental analysis

Scanning electron microscopy was used to examine the morphology of KT particles. Energy-dispersive X-ray spectroscopy was used for elemental measurement, which was combined with scanning electron microscopy (SEM).

Exposure of KT and VCO to SH-SY5Y cell lines

The SH-SY5Y cell line was obtained from the National Centre for Cell Sciences (NCCS) in Pune, India. In a 25 cm2 tissue culture flask, the cell line was cultured in Dulbecco's Modified Eagles medium (DMEM) containing 10 % fetal bovine serum (FBS), L-glutamine, sodium bicarbonate, and an antibiotic solution containing penicillin (100U/ ml), streptomycin (100g/ml), and amphotericin B (2.5g/ml). Cell lines were cultured at 37°C in a humidified 5 percent CO2 incubator (NBS Eppendorf, Germany). In 96-well plates, cell viability was determined using the MTT assay method. The KT and VCO were suspended in cell culture media and exposed to the SH-SY5Y cell line at various concentrations from 6.25 µg to 100 µg.27

Exposure of KT and VCO to Drosophila melanogaster embryo

Drosophila melanogaster stock and culture

The Department of Zoology, University of Mysore, Manasagangotri, Mysore, India provided D. melanogaster wild-type (Oregon K) flies. The flies were maintained and reared in Drosophila Laboratory, on standard Drosophila medium containing 10 g agar, 100 g wheat, 100 g jaggery, 7.5 ml propionic acid (antibacterial and antifungal agent), and yeast at constant temperature and humidity (22–24°C; 60–70 % relative humidity) under 12 h dark/light cycle conditions.
Preparation of Delcour cup for embryo collection

A Delcour cup was prepared by mixing 2 g sucrose and 2 g agar. The ingredients were boiled in 100 ml of distilled water. After removal from the fire, the solution was mixed with 3.5 ml of ethanol and 2.5 ml of acetic acid. Poured into the plastic cup and made into a convex surface. Waited for solidification for 1 hour. Small depression was made throughout the cup to lay the eggs by flies. The yeast paste was placed in the center of the cup for attracting flies.

Collection of embryos

The male and female flies were separated by giving anesthesia to the flies and transferred 200 females and 100 males each to bottles. The flies were fully fed with yeast and kept overnight. The next day all the flies were transferred into the plastic bottle (Figure 7). The Delcour cup containing yeast was kept down and a plastic bottle containing flies was kept above, covered properly, and kept overnight. The next day embryos were collected without damage by the use of a small brush and blade along with the media. Drosophila embryos were transferred to either media only (Group 1) or with the following additives; Group 2) 0.005 % of KT/100 ml of media, Group 3) 0.01 % of KT/100 ml of media, Group 4) 0.05 % of KT/100 ml of media, Group 5) 0.1 % of KT/100 ml of media, Group 6) 1% of KT/100 ml of media, Group 7) 5 % of KT/100 ml of media, and Group 8) 10 % of KT/100 ml of media. The concentrations of KT in culture media were ascertained from the dose calculated from the human dose. For each treatment, there were 7 culture vials, each vial containing 50 embryos (total of 350 embryos/treatment). After 14 days, the number of flies that emerged was counted in every day. The KT in the range of 0.05 % to 10 % of media has shown toxicity in flies. So, we performed the toxicity studies of VCO at 0.005 % to 10 % as well to evaluate whether the toxicity was due to the KT or VCO.

Statistical analysis

To determine whether the difference between treatments was significant, a one-way analysis of variance with Turkey’s post hoc test was used, with the difference considered significant at P≤0.05.

RESULTS AND DISCUSSION

Explanation of the preparation of Karkataka Taila and VCO by the traditional method

Traditional Ayurvedic healers followed a monotonous procedure for the preparation of KT. In the preparation, they were using freshwater crab flesh. Compared to marine crabs these crabs have the adaptability to change to the varying environmental conditions. The Ayurvedic healers collect the crab as fresh as possible to get a significant effect. Further, during the preparation, a constant fire was maintained using wood. Proper
stirring was maintained in one direction without forming any lumps. The consistency of Rasayana was very important. First, the formulation was in the mud stage, then wax, and finally sand stage. Once it reached the sand consistency, the Rasayana was removed from the fire and filtered immediately.

In preliminary zoochemical analysis, KT showed the presence of amino acids and proteins. In addition, the KT was found to contain fats and lipids; phenols, and saponins and this could be due to the VCO. VCO was found to contain all the mentioned phytoconstituents except amino acids and proteins.

**Morphological and elemental analysis**

To investigate the morphology of KT, SEM analysis was performed (Figure 3) and the result revealed that at low magnification, a highly smooth crystal surface was seen. The SEM analysis revealed the Rasayana preparation resulted in the formation of nanocrystals. To confirm the elemental composition EDAX was performed and EDAX has shown the presence of various elements. During the EDAX measurement, different areas were focused and the corresponding peaks were shown (Figure 4). Details of the four EDAX spectra values measured of the Rasayana in atomic and weight % have been listed (Table 1).

**Cell viability study**

Human neuroblastoma SH-SY5Y cell lines were used in the cell culture study to understand the toxicological effects of KT and VCO by the MTT assay method (Figure 5 and Figure 6). SH-SY5Y cell lines were treated with different concentrations of KT and VCO, to assess the percentage of cell viability. The KT and VCO treatment ranged from...
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**Figure 6:** MTT assay of SH-SY5Y cell line after VCO exposure at different concentration.
A. Control. B. 6.25 µg/ml. C. 12.5 µg/ml. D. 25 µg/ml. E. 50 µg/ml. F. 100 µg/ml

**Figure 7:** Toxicological analysis of KT and VCO using Drosophila embryo.
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**Figure 8:** Percentage of cell viability after KT and VCO treatment.

**Figure 9:** Percentage of flies’ survival after KT and VCO treatment respectively.

| Spectrum | KT Weight (%) | KT Atomic (%) | O Weight (%) | O Atomic (%) | Na Weight (%) | Na Atomic (%) | Al Weight (%) | Al Atomic (%) | K Weight (%) | K Atomic (%) |
|----------|---------------|---------------|-------------|-------------|--------------|--------------|--------------|--------------|--------------|--------------|
| Spectrum 1 | 55.05         | 68.30         | 20.95       | 19.51       | 0.46         | 0.30         | 16.98        | 9.38         | 6.57         | 2.50         |
| Spectrum 2 | 55.51         | 68.22         | 24.51       | 22.61       | 0.57         | 0.36         | 8.74         | 4.78         | 10.67        | 4.03         |
| Spectrum 3 | 61.03         | 71.08         | 25.90       | 22.64       | 0.35         | 0.21         | 9.39         | 4.87         | 3.33         | 1.19         |
| Spectrum 4 | 52.73         | 65.13         | 27.92       | 25.89       | 0.54         | 0.35         | 8.80         | 4.84         | 10.00        | 3.79         |

**Table 1:** EDAX weight ratio of Rasayana nanocrystals (four spectrums focused on four distinct areas).

6.25 µg (46.2 % and 46.5 % cell viability respectively), 12.5 µg (66.5 % and 76.1 % cell viability respectively), 25 µg (74.1 and 95.4 % cell viability respectively), 50 µg (53.2 % and 89.2 % cell viability respectively) and 100 µg (47.6 % and 79.3 % cell viability respectively). KT and VCO did not show significant cytotoxicity on SH-SY5Y cell lines up to 25 µg. But, at 50 µg and 100 µg, KT has shown more cytotoxicity than VCO (Figure 8).

**Drosophila embryo study**

The toxicological analysis at different concentrations of KT was performed. The screening was performed in the concentration range from 0.005 % to 10 % KT. At 10 % of KT, the survival rate was found only 21.7 %, then it was found increasing in the order of 29.7 %, 56.50 %, 62.5 %, 65.70 %, 72 %, and 78.8 % at 5 %, 1 %, 0.1, 0.05, 0.01 %, and 0.005 % respectively as compared to control (80 %) i.e., without any treatment. The concentration of KT versus the survival rate of the insects was plotted (Figure 9).

When the concentration of KT increased the survival rate decreased. In the study, VCO was used as a base, and hence a toxicological analysis for VCO was carried out as well. The VCO had shown less toxicity [10 % (66 %), 5 % (68 %), 1 % (70 %), 0.1 % (71.4 %), 0.05 % (73.1 %), 0.01 % (74.8 %), and 0.005 % (76.8 %)] among all the treatments (Figure 9).
The result showed that as the concentration of KT in the medium increased, the rate of larvae transforming into pupae and pupa to adults was slowed. After being swallowed, KT caused toxic effects on the larva's body, slowing its growth and thus delaying the fly's development. Active locomotion of *Drosophila melanogaster* was observed in minor concentrations of KT, whereas activity and locomotion of flies were significantly reduced when the concentration of KT in the media was increased. The Pearson correlation coefficient showed a good correlation between the control and the VCO treated group. When compared to the control, KT treated group, has shown a significant correlation.

**CONCLUSION**

SH-SY5Y cell lines and *Drosophila melanogaster* were utilized in this work to assess the safety of KT or Rasayana. In this study, we demonstrated a simple method for investigating the effects of KT treatment in SH-SY5Y cell lines and *Drosophila melanogaster*. The results indicated that with the increased concentration of KT, the adverse effects on viability of cell lines and the development of the fly. In the presence of relatively high concentrations of KT, developmental processes experienced severe imbalance during the transition from larval to adult stages. *Drosophila* development toxicity and survival rate were compared to an untreated control group. Developmental toxicity is defined as a structural and functional impairment in flies at any stage of their life cycle, including larvae, pupae, and adults. Our findings revealed that when the concentration of Rasayana in the medium increased, there was a noticeable adverse effect on SH-SY5Y cell lines and the number of offspring and larval locomotor behaviour. The pupae’s and larva’s length and width were also observed to be altered. Long-term Rasayana exposure can have a major influence on the cell viability and flies’ survival rate was in a dose and time-dependent way. But the same concentration of VCO has shown a protective effect on cell lines and flies. VCO was used as a vehicle. It can be concluded that the toxic effect could be the presence of protein in crab extract and not due to VCO. The toxicity has been shown only in higher concentrations of KT and the reasonable concentration is safe to use.

**ACKNOWLEDGMENTS**

The authors gratefully acknowledge the generous research infrastructure and support provided by JSS College of Pharmacy, JSS Academy of higher education and research, Rockland’s, Ooty, The Nilgiris, Tamilnadu, India, and Dr. Shyamala Baragur, Professor, Department of Zoology, University of Mysore, Manasagangotri, Mysore for providing necessary facilities and encouragement.

**FUNDING**

The JSS Academy of Higher Education and Research, Mysuru, Karnataka, India, has provided financial support for this study. (REG/DIR(R)/JSSURF/29(1)/2010-11-05/12/2019).

**CONFLICTS OF INTEREST**

No

**LIST OF ABBREVIATIONS**

- DMEM: Dulbecco's Modified Eagles medium
- EDAX: Energy-dispersive X-ray spectroscopy
- KT: Karkataka Taila
- MTT: 3-(4, 5- dimethylthiazol-2-yl)-2, 5-diphenyl tetrazolium bromide
- SEM: Scanning Electron Microscopy
- VCO: Virgin coconut oil

**REFERENCES**

1. Matthews S, Ayurveda. In An Introduction to Complementary Medicine 2020 Jul 16 (pp. 15-32): Routledge.
2. Raghushai PB, Kulkarni P, Sunagar MB. Conceptual study on Aharapaka in Ayurveda. Journal of Ayurveded and Integrated Medical Sciences. 2021 Feb 28;6(01):249-53.
3. Nesari TM, Ayurveda: the promising shelter for the mankind in the wake of COVID-19 pandemic. Journal of Ayurvedic Case Reports. 2020 Jan 1;3(1):1.
4. Ram TS, Munikumar M, Raju VN, Devaraj P, Boiroju NK, Hemalatha R, Prasad PV, Gundeti M, Sisodia BS, Paviar S, Prasad GP. In silico evaluation of the compounds of the ayurvedic drug, AYUSH-64, for the action against the SARS-CoV-2 main protease. Journal of Ayurveda and integrative medicine. 2022 Jan 1;13(1):100413.
5. Parik N, Parikh D, Parikh D. Role of homeopathy in COVID-19 Management-A clinical experience. World J. Pharm. Res. 2020 May;9(5):2459.
6. MAIDEN NM. Therapeutic efficacy of kaubura kudineer (siddha formulation), in covid-19–a review of clinical and molecular docking studies. Asian Journal of Advances in Research. 2021 Aug 14:68-75.
7. Singh AK, Gupta AK, Singh PK. Rasayana therapy: a magic contribution of Ayurveda for healthy long life. International Journal of Research in Ayurveda and Pharmacy (IJRAP). 2014;5(11):417.
8. Baliga MS, Meera S, Shivashankara AR, Palatty FL, Hanidakka R. The health benefits of Indian traditional ayurvedic Rasayana (Anti-Aging) drugs: a review. Foods and dietary Supplements in the Prevention and Treatment of Disease in older adults. 2015 Jan 1:151-61.
9. Baliga M, Meera S, … AS-F and dietary, 2015 undefined. The health benefits of Indian traditional ayurvedic Rasayana (Anti-Aging) drugs: a review. Elsevier [Internet]. [cited 2022 Mar 31]; Available from: https://www.sciencedirect.com/science/article/pii/B9780124186804000166
10. Fredick-WS, Ravichandran S, Balasubramanian T. Toxicity of brachuryan crabs in India. Toxicol Environ Chem. 2011 Feb;93(2):406–11.
11. Pati SK. SYSTEMATIC STUDIES ON FRESHWATER CRABS IN COLLECTION PRESENT IN THE WRC, PUNE.
12. Fazhan H, Waiho K, Ichovunuddin M. Non-indigenous giant mud crab, *Scylla serrata* (Forskål, 1775) (Crustacea: Brachyura: Portunidae) in Malaysian coastal waters: A call for caution. Mar Biodivers Rec. 2017 Jan;10(1).
13. Haruyi E, Dahan K, Tobiga O. Protein and minerals analyses of mangrove crab shells (*Scylla serrata*) from Merauke as a Foundation for Bio-ceramic Components. In Journal of Physics: Conference Series 2019 Apr 1 (Vol. 1204, No. 1, p. 012031). IOP Publishing.
14. Jelin V. Biochemical composition of marine crab *Ocypode brevicornis* and estuarine crab *Scylla serrata*. International Journal of Novel Trends in Pharmaceutical Sciences. 2017 Feb 28;7(1):27-30.
15. Viswam D. Investigation of nutritive value of crabs along Kerala coast. Final Report of Minor Research Project. 2015:29.
16. Ramamoorthy N, Sri R, Priyadarshini S, Karuppasamy PK. Nutritional quality of the edible *Brachyura* crabs from the southeast coast of India. Journal of Marine Biosciences. 2015;2(1):90-101.
17. Chinlampianga M, Singh RK, Shukla AC. Ethnozoological diversity of Northeast India: Empirical learning with traditional knowledge holders of Mizoram and Arunachal Pradesh. Indian J Tradit Knowl. 2013;12(1):18–30.
18. Deb AK, Haque CE. ‘Every mother is a mini-doctor’: Ethnomedical uses of fish, shellfish and some other aquatic animals in Bangladesh. Journal of ethnopharmacology. 2011 Mar 24;134(2):259-67.
19. Majumder SC, Dei A. RECORDS OF THE ZOOLOGICAL SURVEY OF INDIA.
20. Wang X, Yu H, Xing R, Li P. Characterization, preparation, and purification of marine bioactive peptides. BioMed research international. 2017 Jul 6;2017.
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21. Deep VC, Acharya MV. A CLINICAL STUDY OF KNEE JOINT LIGAMENT INJURY WITH KARKADATAILA:A CASE REPORT. International Journal of Ayurveda and Pharma Research. 2017 Mar 5.
22. Lavekar GS. Inventory of animal products used in Ayurveda. Siddha and Unani. 2008;2:463-70.
23. Menon NM, Adiga M, Pady AE. Understanding Parkinson’s Disease (PD) in Ayurvedic Prospective. International Journal of Ayurveda and Pharma Research. 2021 Aug 4:86-92.
24. Amulya GV, Desai AS, Borannavar S. Role of Panchakarma in the management of Parkinson’s Disease: A Case Study. Journal of Ayurveda and Integrated Medical Sciences. 2020 Oct 31;5(05):548-51.
25. Li S, Le W. Milestones of Parkinson’s Disease Research: 200 Years of History and Beyond. Neurosci Bull. 2017 Oct 1;33(5):598–602.
26. Statistics | Parkinson’s Foundation [Internet]. [cited 2022 Mar 31]. Available from: https://www.parkinson.org/Understanding-Parkinsons/Statistics
27. Rajan R, Divya KP, Kandadai RM, Yadav R, Satagopam VP, Madhusoodanan UK, et al. Genetic architecture of parkinson’s disease in the indian population: Harnessing genetic diversity to address critical gaps in parkinson’s disease research. Front Neurrol. 2020;11:1–11.
28. Singh N, Chaudhary A. A comparative review study of Sneha Kalpana (Paka) vis-a-vis liposome. Ayu. 2011 Jan;32(1):103.
29. Martinez MA, Rodriguez JL, Lopez-Torres B, Martinez M, Martinez-Larrañaga MR, Maximiliano JE, Anadón A, Ares I. Use of human neuroblastoma SH-SY5Y cells to evaluate glyphosate-induced effects on oxidative stress, neuronal development and cell death signaling pathways. Environment international. 2020 Feb 1;135:105414.
30. Rocha JB. Drosophila melanogaster as a promising model organism in toxicological studies. Archives of Basic and Applied Medicine. 2013 Oct 31;1(1):33-8.
31. Evans WC. Trease and Evans’ pharmacognosy. Elsevier Health Sciences; 2009 May 27.
32. Harborne AJ. Phytochemical methods a guide to modern techniques of plant analysis. springer science & business media; 1996 Apr 30.
33. Ramkumar M, Rajasankar S, Gobi VV, Dhanalakshmi C, Manivasagam T, Justin Thenmozhi A, Essa MM, Kalandar A, Chidambaram R. Neuroprotective effect of Demethoxycurcumin, a natural derivative of Curcumin on rotenone induced neurotoxicity in SH-SY 5Y Neuroblastoma cells. BMC complementary and alternative medicine. 2017 Dec;17(1):1-1.

GRAPHICAL ABSTRACT

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Dr. B. Duraiswamy completed his Bachelor of Pharmacy, Master of Pharmacy, and Ph.D. from JSS College of Pharmacy, Ooty, which is a constituent college under JSSAHER, Mysuru. He has published more than 121 research articles with more than 978 citations. He is having experience in academics for more than 30 years from JSS College of Pharmacy, Ooty. He received several grants from various government funding agencies. He Guided more than 50 postgraduate students and 15 Ph.D. students. Currently, he is working as a Principal, at JSS College of Pharmacy, Jammu, India.

Cite this article: Deepika NP, Baragur S, Naik MR, Kalakotla S, Muhasina KM, Ghosh P, et al. Preparation of Karkataka Taila, an Edible crab Rasayana, and assessment of its toxicological effects on SH-SY5Y cell line and on Drosophila melanogaster embryos. Pharmacogn J. 2022;14(4): 423-431.