IJMPR 2021, 5(2), 49-55

International Journal of Modern Pharmaceutical Research
www.ijmpronline.com

ISSN: 2319-5878
IJMPR
Research Article

SJIF Impact Factor: 5.273

TOXICITY STUDY OF *CORIANDRUM SATIVUM LINN*

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Received on: 27/01/2021
Revised on: 17/02/2021
Accepted on: 07/03/2021

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ABSTRACT

The aim of the present work is to evaluate the acute toxicity study of dry powder *Coriandrum sativum Linn* leaves. The leaves of this plant were collected from Rajgurunagar area of Pune district, Maharashtra, INDIA. The fresh leaves were dried in shade till constant weight for few days and grinded with high power electric mixer. The dry sample was kept in airtight plastic container and was used for toxicity study as per OECD guidelines by using white albino Wister Rats. The plant material was administered orally at dose of 2 to 10gm/Kg body weight of Swiss mice. The animals were observed continuously for the period of first 4 hours continuously for behavioral changes and then they were kept under observation for 14 days after single administration of powder in the form of aqueous slurry with the help of gavage. The mortality observations were recorded to find out the toxic effect of leaves of *Coriandrum sativum Linn*. From these results it is observed that *Coriandrum sativum Linn* leaves powder at higher doses of 10gm/kg body weight is found to be nontoxic in male as well as in female, as no any type of abnormal changes were reported in behavior, food and water intake of the administered animals. The *Coriandrum sativum Linn* leaves powder was found to be relatively safe when administered orally in Swiss mice. Lethality or adverse toxic signs were not at all observed during the experimental period for our sample.

KEYWORDS: *Coriandrum sativum Linn*, Lethality, acute toxicity.

INTRODUCTION

The coriander leaves have a different taste from the seeds, with citrus overtones. In addition to volatile oils, caffeic acid and flavonoid glycosides have been isolated from coriander leaves.[1] Some people may be genetically predisposed to find the leaves to have unpleasant soapy taste or a rank smell. The fresh leaves are an ingredient in many South Asian foods (such as chutneys and salads); in Chinese and Thai dishes; in Mexican cooking, particularly in salsa and guacamole and as a garnish; and in salads in Russia. In Portugal, chopped coriander is used in the bread soup Açorda, and in India, chopped coriander is a garnish on Indian dishes such as dal. As heat diminishes their flavor, coriander leaves are often used raw or added to the dish immediately before serving. In Indian and Central Asian recipes, coriander leaves are used in large amounts and cooked until the flavor diminishes. The leaves spoil quickly when removed from the plant, and lose their aroma when dried or frozen. The nutritional profile of coriander seeds is different from the fresh stems or leaves. Leaves are particularly rich in vitamin A, vitamin C and vitamin K, with moderate content of dietary minerals. Although seeds generally have lower content of vitamins, they do provide significant amounts of dietary fiber, calcium, selenium, iron, magnesium and manganese.

Coriander leaves and seeds are widely used in folk medicine as a cholesterol-lowering agent, a digestive stimulant, and an anti-hypertensive agent,[2] in addition to its use as a seasoning in food preparation. Pharmaceutical applications of coriander have also revealed antibacterial,[3] antioxidant,[4] hepatoprotective,[5] and anticonvulsant,[6] activities.

The essential oil from coriander has been proven in test tube and petri dish studies to have a strong antifungal effect against Candida species.[7] However, most studies have analyzed the essential oil from fruits,[8] and seeds,[9] which have a different chemical composition from those present in the leaves.[10] Previous studies have shown that the major components of coriander leaf essential oil are alcohols and aldehydes.[11] with decanal, trans-2-decenal, 2-decen-1-ol and cyclodecane as the most prominent compounds.[12] Most of these analytes have also been

found as major constituents of coriander leaf samples from Kenya, U.S., Bangladesh, Fiji and Brazil. The mono- and sesquiterpenes found in coriander leaf essential oil may be related to the antifungal activity observed. Natural products are considered strong inhibitors of microbial activity when minimum inhibitory concentration [MIC] (the lowest concentration of a chemical which prevents visible growth of a microorganism) values are lower than 500 µg/ml.[13]

In the contrary, Sagdic et al.[14] tested 18 extracts of plant spices commonly grow in Turkey including coriander (Coriandrum sativum) against 23 microorganisms. Coriander did not show bactericidal activity.[15] Ates et al.[16] studied 5 plants extracts against 13 bacteria. Coriander had no antibacterial effect to the microorganisms tested. Chaudhury et al.[17] used aqueous decoction of 4 plants against oral pathogens. Similar to our results, coriander did not exhibit any antibacterial activity to the tested organisms.[18]

Pharmacological studies in animals have shown that coriander has anti-diabetic,[24], hypolipidemic,[19] and anti-cancer effects.[20] Sedative-hypnotic activity of coriander seeds have been evaluated in scientific studies in mice.[21] Linalool, the main monoterpenoids of coriander seeds is shown to have sedative and anticonvulsant activity in animal studies and anxiolytic and sedative activity in human studies.[22] Report also states the in vivo antioxidant activities of coriander seed.[23]

In another test tube study, the ethyl acetate extract of coriander root has antioxidant and anticancer properties. Coriander root inhibited DNA damage in fibroblasts and prevented MCF-7 breast cancer cell migration induced by H_2O_2, suggesting its potential in cancer prevention and inhibition of metastasis.[24] The herb exhibited anticancer activity in MCF-7 breast cancer cells by affecting antioxidant enzymes leading to H_2O_2 accumulation, cell cycle arrest at the G_2/M phase and apoptotic cell death by the death receptor and mitochondrial apoptotic pathways. High levels of H_2O_2 can produce cancer cell death.[25]

Although coriander has been reported to possess a wide range of traditional medicinal uses, there are currently no well-designed clinical trials to corroborate those traditional medicine uses of coriander. Therefore we do not recommend using coriander as therapeutic medicine, instead we support coriander uses in foods and cooking.

The use of natural medicines is increasing and is a persistent aspect of present day health care. More and more people are using herbal medicines as OTC products. There is a belief of many consumers that naturalness is a guarantee of harmlessness, but this is not true. Many traditionally used medicines can produce dangerous and sometimes even lethal poisoning. The world health organization (WHO) is fully aware of the importance of herbal medicines to the health of many people throughout the world. Thus herbal medicines have been recognized as a valuable and readily available resource of primary health care and WHO have endorsed their safe and effective use.[26] A few herbal medicines have withstood scientific testing but others are simply used for traditional reasons to protect, restore and improve health. The WHO has set guidelines for toxicity studies of herbal medicines. It supports appropriate usage of herbal medicines and encourages the remedies, which are proved to be safe and effective. The route for administration for subacute, subchronic and chronic toxicity can be any one of the above stated routes, but most often it is by oral route

Toxic Dose

P**oison** is any agent capable of producing a deleterious response in a biological system, seriously injuring function or producing death. Among chemicals there is a wide spectrum of doses needed to produce deleterious effects, serious injury or death. Some chemicals, which produce death in microgram doses, are extremely poisonous, while others may be relatively harmless after doses in excess of several grams.[27]

A chemical agent does not produce toxic effects in biological system unless that agent or its metabolic breakdown (biotransformation) products reach appropriate sites in the body at a concentration and for a length of time, sufficient to produce a toxic manifestation.[28] The major factors which influence toxicity are the route of administration, the duration and the frequency of exposure to the chemical agent. Toxicologists usually divide the exposure of animals into Acute toxicity, Subacute toxicity, Subchronic toxicity, Chronic toxicity.[32,33,34]

Limit Test

All chemicals can produce toxicity under some experimental conditions, for instance, if a sufficiently large dose is administered. It is therefore, misleading to conduct acute toxicity studies at unreasonably high dose levels for the sake of demonstrating lethality and / or toxicity, which may be irrelevant to the use of compound itself. An extremely high dose of a practically nontoxic compound for example, can cause gastrointestinal blockage, which in turn can result in gastrointestinal tract dysfunction,[35,36,37,38] Toxicity in such a case is not related to the intrinsic characteristic of the test substance, since effect manifested is a direct result of the physical blockage caused by the biologically inert substance. There must be a point, however, at which an investigator may conclude that a test substance is practically nontoxic or nonlethal after an acute exposure. This test limit for oral toxicity generally is considered to be 5.0 g / Kg body weight. If no mortality is observed at this dose level, a higher dose level generally is not necessary.

MATERIALS AND METHODS

Acute Toxicity Study of *Coriandrum sativum Linn* leaves powder

An acute toxicity study was carried out for *Coriandrum sativum Linn* leaves by using mice as the experimental model.[39,40,41] The study was carried out to assess the acute toxicity of the slurry of leaves powder of *Coriandrum sativum Linn* on oral administration. Study protocol is given below in table 1

Table 1: Study Protocol.

Name of the study	Acute toxicity study
Test material	*Coriandrum sativum Linn leaves powder*
Animal model	Albino Swiss Mice
Animals procured from	Raj Biotech (INDIA) Ltd., Pune
Sex	Male and Female
Weight range of animals	Between 35 to 55 g
No. of dose groups	Five groups
Animals per group	1 male and 1 female
Route of administration	Intragastric administration with the help of gavage No. 16
Dose volume	2.0 ml per animal
Vehicle for administration	Distilled water
No. of administrations	Single
Concentration of dose	2, 4, 6, 8 and 10gm/Kg body weight
Study duration	Acclimatization for 14 days, one day drug administration and 14 days observation period including holidays
Parameters observed	Cage side observations, daily food and water intake, daily body weight and daily mortality record etc

Animal Maintenance

The animals were housed in polyurethane cages. The cages were provided with rice husk bedding and were cleaned daily. The animals were provided with drinking water ad libitum and were fed on commercially available Mice feed supplied by AMRUT FEED. The specifications of the feed are listed below in table 2.[42,43]

Table 2: Composition of feed.

Name	Percentage
Crude Protein	20 - 21 % minimum
Ether Extractive	04 - 05 % minimum
Crude Fiber	04 % maximum
Ash	08 % maximum
Calcium	1.2%
Phosphorus	0.6 % minimum
NFE	54 %
ME Kcal/Kg	3600
Pallet Size	12 mm

The feed was enriched with stabilized vitamins such as Vit. A and D_3, Vit. B_{12}, Thiamine, Riboflavin, Folic acid and supplemented with all minerals and microelements. Measured quantities of water and feed were supplied daily in each cage. The consumption of water and food was estimated from the amount of water remaining in feeding bottles and from the amount of feed remaining in the feed hopper.

RESULTS AND DISCUSSION

Cage Side Observations

Assessment of the behavior of animals was carried out by general observations of each animal on a daily basis from the stage of dosing to the end of the study. Cage-side observations included daily recording of condition of the fur; damaged areas of skin; subcutaneous swellings or lumps (the size, shape and consistency), areas of tenderness, abdominal distension, eyes - for dullness, discharges, opacities, pupil diameter, ptosis (drooping of upper eyelid), the colour and consistency of the faeces, wetness or soiling of the perimenum, condition of teeth, breathing abnormalities, gait, etc. Any changes or abnormalities recorded could be an indication of toxicity. The test animals at all dose levels showed no significant changes in behavior before and after the administration of an oral dose of *Coriandrum sativum Linn* leaves powder in the form of aqueous slurry following table 3 shows the dosage regime. Table 4 shows the observations for the parameters studied. Table 5 shows the mortality record.

Table 3: Doses Regime.

Sr. No.	Sex	Dose gm./Kg Body Wt.	No. of animals used	Total Vol. administered in cm3
1	Male	2	1	2.00
2	Female	2	1	2.00
3	Male	4	1	2.00
4	Female	4	1	2.00
5	Male	6	1	2.00
6	Female	6	1	2.00
7	Male	8	1	2.00
8	Female	8	1	2.00
9	Male	10	1	2.00
10	Female	10	1	2.00

Table 4: Cage Side Observations for all animals.

Sr. No.	Parameters	Cage Side Observations
1	Condition of the fur	Normal
2	Skin	Normal
3	Subcutaneous swellings	Nil
4	Abdominal distension	Nil
5	Eyes -dullness	Nil
6	Eyes - opacities	Nil
7	Pupil diameter	Normal
8	Ptosis	Nil
9	Colour and consistency of the faeces	Normal
10	Wetness or soiling of the perimenum	Nil
11	Condition of teeth	Normal
12	Breathing abnormalities	Nil
13	Gait	Normal

Table 5: Mortality Record.

Group ml/Kg	2	2	4	4	6	6	8	8	10	10
Sex	**Male**	**Female**	**Male**	**Female**	**Male**	**Female**	**Male**	**Female**	**Male**	**Female**
Hr. 1	-	-	-	-	-	-	-	-	-	-
Hr. 2	-	-	-	-	-	-	-	-	-	-
Hr. 3	-	-	-	-	-	-	-	-	-	-
Hr. 4	-	-	-	-	-	-	-	-	-	-
Day 1	-	-	-	-	-	-	-	-	-	-
Day 2	-	-	-	-	-	-	-	-	-	-
Day 3	-	-	-	-	-	-	-	-	-	-
Day 4	-	-	-	-	-	-	-	-	-	-
Day 5	-	-	-	-	-	-	-	-	-	-
Day 6	-	-	-	-	-	-	-	-	-	-
Day 7	-	-	-	-	-	-	-	-	-	-
Day 8	-	-	-	-	-	-	-	-	-	-
Day 9	-	-	-	-	-	-	-	-	-	-
Day 10	-	-	-	-	-	-	-	-	-	-
Day 11	-	-	-	-	-	-	-	-	-	-
Day 12	-	-	-	-	-	-	-	-	-	-
Day 13	-	-	-	-	-	-	-	-	-	-
Day 14	-	-	-	-	-	-	-	-	-	-
Mortality	**0/1**	**0/1**	**0/1**	**0/1**	**0/1**	**0/1**	**0/1**	**0/1**	**0/1**	**0/1**

Body Weight Changes

Body weight is an important factor to monitor the health of an animal. Loss in body weight is frequently the first indicator of the onset of an adverse effect. A dose, which causes 10 % or more reduction in the body weight, is considered to be a toxic dose. It is considered to be the dose, which produces minimum toxic effect, irrespective of whether or not it is accompanied by any other changes. All the animals from treated groups did not show any significant decrease in body weights for all the

14 days as compared with the 0 day values, indicating no signs of toxicity against powder of leaves of *Coriandrum sativum Linn*. The variation in body weight changes of males and females and the data is given in Table 6.

Table 6: Daily Body Weight Record in Grams.

Group gm/Kg	2	2	4	4	6	6	8	8	10	10
Sex	**Male**	**Female**	**Male**	**Female**	**Male**	**Female**	**Male**	**Female**	**Male**	**Female**
Day 0	56	36	45	38	38	46	58	48	55	36
Day 1	55	36	46	38	37	47	58	48	56	36
Day 2	54	34	45	38	37	45	57	47	54	36
Day 3	54	36	46	38	37	45	56	46	55	35
Day 4	56	38	46	39	37	47	57	48	56	38
Day 5	55	37	46	39	39	46	55	45	47	39
Day 6	47	43	44	49	48	45	47	48	48	49
Day 7	43	42	44	49	47	48	48	49	47	48
Day 8	54	34	45	36	36	45	56	46	56	36
Day 9	55	35	45	37	36	46	56	47	55	36
Day 10	55	36	46	37	36	46	56	47	54	34
Day 11	51	35	44	36	35	46	55	46	55	35
Day 12	55	35	46	38	38	46	57	47	55	36
Day 13	55	36	46	37	38	46	57	47	56	36
Day 14	43	42	44	49	47	48	48	49	47	48

Food and Water Consumption

There was no significant change in food and water intake of the test animals at all dose levels. The data for food and water consumption is given in Tables **7** and **8** respectively.

Table 7: Daily Food Intake Record in Grams.

Group gm/Kg	2	2	4	4	6	6	8	8	10	10
Sex	**Male**	**Female**	**Male**	**Female**	**Male**	**Female**	**Male**	**Female**	**Male**	**Female**
Day 0	18	12	18	14	22	15	18	14	12	18
Day 1	18	11	18	14	22	15	18	14	11	18
Day 2	19	11	18	14	23	13	18	14	11	18
Day 3	17	15	14	17	16	15	17	18	17	19
Day 4	16	15	14	15	16	15	16	17	16	18
Day 5	15	10	15	14	20	15	15	14	10	15
Day 6	17	17	15	16	16	15	17	17	16	16
Day 7	18	14	15	17	17	16	16	17	16	18
Day 8	15	11	16	14	21	14	16	14	11	16
Day 9	16	12	16	14	21	14	16	14	12	16
Day 10	15	12	16	14	21	14	16	14	12	16
Day 11	16	11	16	14	22	14	16	14	11	16
Day 12	15	10	15	14	20	15	15	14	10	15
Day 13	17	12	17	15	22	14	17	15	12	17
Day 14	17	12	17	14	22	14	17	14	12	17

Table 8: Daily Water Intake Record in ml.

Group gm/Kg	2	2	4	4	6	6	8	8	10	10
Sex	**Male**	**Female**	**Male**	**Female**	**Male**	**Female**	**Male**	**Female**	**Male**	**Female**
Day 0	14	12	15	14	22	11	14	12	12	15
Day 1	15	12	16	14	22	12	14	12	12	16
Day 2	15	11	15	14	22	12	14	11	11	15
Day 3	14	12	16	13	23	12	13	12	12	16
Day 4	15	11	16	13	21	12	13	11	11	16
Day 5	16	12	17	14	23	13	14	12	12	17
Day 6	17	11	17	13	22	13	13	11	11	17
Day 7	17	11	18	14	23	12	14	11	11	18
Day 8	13	11	15	14	20	13	14	11	11	15

Day 9	12	11	15	14	20	13	14	11	11	15
Day 10	13	12	14	13	19	14	13	12	12	14
Day 11	14	12	14	13	21	14	13	12	12	14
Day 12	14	12	14	15	21	14	15	12	12	14
Day 13	15	13	13	15	21	14	15	13	13	13
Day 14	13	12	15	14	20	13	14	12	12	15

Mortality

Mortality is the main criteria in assessing the acute toxicity (LD_{50}) of any drug. There was no mortality recorded even at the highest dose level i.e. 10gm/ Kg. body weight.

CONCLUSION

From the results of this study, it is observed that there is no considerable change in body weight, food and water consumption by the animals from all dose groups (2gm/Kg body weight to 10gm/Kg body weight), There was no mortality recorded even at the highest dose level i.e. 10gm/Kg body weight, which proves that the powder of leaves of *Coriandrum sativum Linn* has no significant toxic effect in mice.

REFERENCES

1. The Wealth of India: Raw Material, Publication & Information Directorate, CSIR, New Delhi, India, 1972; VI: 31-34.
2. Gupta K, Thakral KK, Arora SK, Wagle DS: Studies on growth, structural carbohydrates and phytate in coriander (Coriander sativum) during seed development. J Sci Food Agric, 1986; 54: 43–46.
3. Grieve M: A Modern Herbal, Vol. 1 (Leyel H, editor., ed.) Dover Publications, New York, 1971.
4. Antioxidant and free radical scavenging activities of some leafy vegetables. Bajpai M, Mishra A, Prakash D. Int J Food Sci Nutr, 2005 Nov; 56(7): 473-81.
5. United States Department of Agriculture Agricultural Research Service. National Nutrient Database for Standard Reference Release, 28.
6. Snigdha C, Monika T Coriandrum sativum: A promising functional and medicinal food. Int J Phytomed Related Industr, 2013; 5: 59–65.
7. Antimicrobial Activity of Essential Oils against Streptococcus mutans and their Antiproliferative Effects. Galvão LC, Furletti VF, Bersan SM, da Cunha MG, Ruiz AL, de Carvalho JE, Sartoratto A, Rehder VL, Figueira GM, Teixeira Duarte MC, Ikegaki M, de Alencar SM, Rosalen PL.Evid Based Complement Alternat Med, 2012; 2012: 751435.
8. In vitro free radical scavenging and DNA damage protective property of Coriandrum sativum L. leaves extract. Harsha SN, Anilakumar KR. J Food Sci Technol, 2014 Aug; 51(8): 1533-9.
9. Protective effects of Coriandrum sativum extracts on carbon tetrachloride-induced hepatotoxicity in rats. Sreelatha S, Padma PR, Umadevi M. Food Chem Toxicol, 2009 Apr; 47(4): 702-8.
10. Emamghoreishi M, Heidari-Hamedani GH Effect of extract and essential oil of Coriandrum sativum seed against pentylenetetrazole-induced seizure. Pharm Sci. 2008; 7: 1–1012.
11. Antifungal activity, toxicity and chemical composition of the essential oil of Coriandrum sativum L. fruits. Soares BV, Morais SM, dos Santos Fontenelle RO, Queiroz VA, Vila-Nova NS, Pereira CM, Brito ES, Neto MA, Brito EH, Cavalcante CS, Castelo-Branco DS, Rocha MF. Molecules, 2012 Jul 11; 17(7): 8439-48.
12. Antifungal activity of Coriandrum sativum essential oil, its mode of action against Candida species and potential synergism with amphotericin B. Silva F, Ferreira S, Duarte A, Mendonça DI, Domingues FC. Phytomedicine, 2011 Dec 15; 19(1): 42-7.
13. Action of Coriandrum sativum L. Essential Oil upon Oral Candida albicans Biofilm Formation. Furletti VF, Teixeira IP, Obando-Pereda G, Mardegan RC, Sartoratto A, Figueira GM, Duarte RM, Rehder VL, Duarte MC, Höfling JF. Evid Based Complement Alternat Med., 2011; 2011: 985832.
14. Matasyoh JC, Maiyo ZC, Ngure RM, Chepkorir R Chemical composition and antimicrobial activity of the essential oil of Coriandrum sativum. Food Chem, 2009; 113: 526–529.
15. Freires I de A, Murata RM, Furletti VF, et al. Coriandrum sativum L. (Coriander) Essential Oil: Antifungal Activity and Mode of Action on Candida spp., and Molecular Targets Affected in Human Whole-Genome Expression. Mylonakis E, ed. PLoS ONE, 2014; 9(6): e99086.
16. Activity of essential oils from Brazilian medicinal plants on Escherichia coli. Duarte MC, Leme EE, Delarmelina C, Soares AA, Figueira GM, Sartoratto A. J Ethnopharmacol, 2007 May 4; 111(2): 197-201.
17. Sagdic O, Karahan AG, Ozcan M, Ozcan G. Effect of some spice extracts on bacterial inhibition. Food Sci Technol Int., 2003; 9: 353–356.
18. Ates DA, Ergogrul OT. Antimicrobial activity of various medicinal and commercial plant extracts. Turk J Biol., 2003; 27: 157–162.
19. Bactericidal activity of black pepper, bay leaf, aniseed and coriander against oral isolates. Chaudhry NM, Tariq P. Pak J Pharm Sci., 2006 Jul; 19(3): 214-8.
20. Chithra V, Leelamma S. Coriandrum sativum-mechanism of hypoglycemic action. Food Chem, 1999; 67: 229–231. doi: 10.1016/S0308-8146(99)00113-2.
21. Coriandrum sativum–effect on lipid metabolism in 1,2-dimethyl hydrazine induced colon cancer. Chithra V, Leelamma S. J Ethnopharmacol, 2000 Aug; 71(3): 457-63.

22. Coriandrum sativum: evaluation of its anxiolytic effect in the elevated plus-maze. Emamghoreishi M, Khasaki M, Aazam MF. J Ethnopharmacol, 2005 Jan 15; 96(3): 365-70.
23. Karmakar UK, Rahman MA, Roy DN, Sadhu SK, Ali ME. Chemical and biological investigations of Coriandrum sativum L. Int J Pharm Sci Res., 2011; 2(4): 999–1006.
24. Effect of coriander seed powder (CSP) on 1, 2-dimethyl hydrazine-induced changes in antioxidant enzyme system and lipid peroxide formation in rats. Anilakumar KR, Khanum F, Bawa AS. J Diet Suppl, 2010 Mar; 7(1): 9-20.
25. Tang EL, Rajarajeswaran J, Fung SY, Kanthimathi M. Antioxidant activity of Coriandrum sativum and protection against DNA damage and cancer cell migration. BMC Complementary and Alternative Medicine, 2013; 13: 347. doi:10.1186/1472-6882-13-347.
26. Dual role of hydrogen peroxide in cancer: possible relevance to cancer chemoprevention and therapy. López-Lázaro M. Cancer Lett, 2007 Jul 8; 252(1): 1-8. https://www.ncbi.nlm.nih.gov/pubmed/17150302
27. Research guidelines for evaluating the safety and efficacy of herbal medicine, World Health Organisation Regional Office for the Western Pacific Manila, 1993; 1-9.
28. John H. Duffus, Fundamental Toxicology for Chemists, Ed. John H. Duffus and Horward G. J. Worth, Royal Society of Chemistry, 1996; 1-5.
29. Trevan J.W., The error of determination of toxicity, Proc. R. Soc. Lond., 1927; 101B: 483-514.
30. David L. Eaton and Curtis D. Klassen, Casarett and Doull's Toxicology. The Basic Science of Poison, Ed. Curtis D. Klassen, International edition, McGrath-Hill Health Professions Division, 5th edition, 1996; 2: 13.
31. EPA: EPA fact sheet: Background on acute toxicity testing for chemical safety, August 1984.
32. FDA: "Final report on acute studies workshop" Sponsored by the U.S. Food and Drug Administration on November 9, 1983.
33. Kennedy G.L et al, "J. Appl. Toxicol.", 1986; 24: 457- 463.
34. Pingale S. S., Pokharkar Raghunath D. Acute toxicity study for Cissus quadrangular is whole plant powder, Pharmacology online Newsletter, 2008; 2: 256-262.
35. Pingale S. S. Acute toxicity study for Centella asiatica whole plant powder, Pharmacology online Newsletter, 3: 80-84. [13] Pingale S. S. (2010) Acute Toxicity Study of Ocimum Sanctum, IRJP, 2008; 1: 409- 413.
36. Pingale S.S. Markandeya Anil Ganpat, Gawali Sunita. Toxicity Study for Celocia argentea Leaves. IRJP, 2011; 2(1): 263-266.
37. Pingale S.S. Hepatoprotective Action of Terminalia belericaon CCl4 Induced Hepatic Disorders, Scholars Research Library, Der Pharma Chemica, 2011; 3(1): 42- 48.
38. Pingale S. S., Virkar P. S. Evaluation of Acute Toxicity for Abutilon Indicum, Scholars Research Library, Der Pharmacia Lettre, 2011; 3(3): 37-42. Curr. Pharm. Res., 2019; 9(2): 2734-2742. doi: 11.258369/jcpr-322 2742.
39. Pingale S. S., Shewale S. S. Acute Toxicity Study of Phyllanthus Amarus, International Journal of Pharmaceutical Sciences Review and Research, 2011; 9(1): 81-84.
40. Pingale S. S., Avvaru R. K. Acute Toxicity Study for Achyranthes aspera Leaves, Journal of Pharmacy Research, 2011; 4(7): 2221-2222.
41. Pingale S. S. Acute Toxicity Study For Tinospora Cordifolia, International Journal of Research in Ayurveda and Pharmacy, 2011; 2(5): 1571-1573.
42. Pingale S. S. Acute Toxicity Study for Ricinus communis, Der Pharmacia Lettre, 2011; 3(5): 132-137.
43. Pingale S. S., More B. P. Toxicity Study of Terminalia chebula. World Journal of Pharmaceutical Research, 2014; 3(2): 2127-2134.