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***GYROCARPUS ASIATICUS* WILLD AND *LACTUCA RUNCINATA* DC: A NARRATIVE REVIEW**

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ABSTRACT

The present study is aimed at reviewing the phytochemistry and pharmacological activities of *Gyrocarpus asiaticus* Willd and *Lactuca runcinata* DC. The results of the current study are based on literature research on phytochemistry and pharmacological properties of *Gyrocarpus asiaticus* & *Lactuca runcinata*. These plants are valuable for antibacterial, anthelmintic, cardiotoxic, antioxidant, cytotoxic (anti-cancer), anti-diabetic, hypolipidaemic and hepatoprotective effect. Toxicity study of the plant extracts were regarded as safe for animals. Both the plants were revealed the various phytoconstituents such as alkaloids, cardiac glycosides, flavonoids, phenols, saponins, steroids, tannins and terpenoids which are may be responsible for different pharmacological activities. This literature review report of the plants would provide a basis for phytochemistry and pharmacological screening & are safe for the development of medicines and it will be more useful for researcher for further research work.

Keywords: *Gyrocarpus asiaticus*, *Lactuca runcinata*, Phytochemistry, Pharmacology, GC-MS

INTRODUCTION:

Plants or parts of plants are widely used in the medicine since ancient times and now a days, use of phyto-medicine against various disease is an important key factor of health system. *Gyrocarpus asiaticus* Willd commonly known as Taniki or Nalla poliki [1] is a tree belonging to the family Hernandiaceae. *Gyrocarpus asiaticus* Willd is one of the species in the genus *Gyrocarpus* with the class Magnoliopsida. *Gyrocarpus asiaticus* have different kinds of pharmacological behaviors such as antioxidant activity, [2] anthelmintic activity, anti-cancer activity [3].

Lactuca runcinata DC [*L. runcinata*, Synonym-*Lactuca heyneana* DC.] commonly known as Undirachakam [4] or Atheli is an annual erect herb belonging to the family Compositae (Asteraceae). Traditionally this plant finds its wide applicability as diuretic and in chronic obstruction of liver and bowel [4]. *Lactuca runcinata* DC also has been reported to be a valuable source of essential nutrients, such as carbohydrate, protein, fat etc. and micro-nutrients like calcium, iron, phosphorous etc. Chewing *Lactuca runcinata* with betel leaf is useful to cure the blisters of mouth and tongue [5].

The present study are based on literature search on phytochemistry and

pharmacological properties of *Gyrocarpus asiaticus* Willd & *Lactuca runcinata* DC using information derived from pre-electronic sources (such as journals, books etc.) and electronic sources (like several internet sources such as Pubmed, Google Scholar, Elsevier, Scopus, Science Direct etc.).

PHYTOCHEMICAL ANALYSIS:

Kanthal *et al.* [4] reported the phytochemical screening [6-9] conducted on methanol extract of *Gyrocarpus asiaticus* revealed the presence of alkaloids, cardiac glycosides, flavonoids, phenols, saponins, steroids, tannins and terpenoids. The GC-MS analysis [10] of *Gyrocarpus asiaticus* resulted in the identification of fifteen compounds (**Table 1 and Figure 1**).

In 2014, Kanthal *et al* [11] carried out the phytochemical screening [6-9] of methanol extract of *Lactuca runcinata* revealed the presence of alkaloids, cardiac glycosides, flavonoids, phenols, phlobatannin, reducing sugars, saponins, steroids, tannins and terpenoids. The phytochemical analysis (GC-MS study) [11] of *Lactuca runcinata* resulted in the identification of twenty one compounds (**Table 2 and Figure 2**).

Table 1: Identification of Chemicals constituents of *G. asiaticus* Willd methanolic extract by GC-MS [4]

Compound No.	Retention time	Compound Name	Compound Nature	Molecular formula	Molecular weight	Peak Area (%)
1	23.61	4-Normethyl-9,19-cyclolanostan-7-one, 3-acetoxy	Silyl steroidal-oxime	C ₃₁ H ₅₀ O ₃	470	2.03
2	29.55	Flurandrenolide	Fluro-steroid	C ₂₄ H ₃₃ FO ₆	436	1.95
3	32.96	Cholestanol[7,8-a]cyclobutane, 3-methoxy-6-oxo-2'-methylene-	Steroid	C ₃₁ H ₅₀ O ₂	454	2.11
4	33.24	Difuro[2',3':5,6:3'',2''':7,8]perylol[1,12 def][1,3]dioxepin-8,15-dione, 10,11,12,13-tetrahydro-1,7-dihydroxy-10,13-dimethyl-	Fused Hetero-Cyclic Ketone	C ₂₇ H ₁₈ O ₈	470	2.17
5	33.62	9,19-Cyclolanostane-6,7-dione, 3-acetoxy-	Steroid	C ₃₂ H ₅₀ O ₄	498	3.60
6	34.27	3-[18-(3-Hydroxy-propyl)-3,3,7,12,17-pentamethyl-2,3,22,24-tetrahydroporphin-2-yl]propan-1-ol	Prophinol	C ₃₁ H ₃₈ N ₄ O ₂	498	2.52
7	35.68	4-Normethyl-9,19-cyclolanostan-7-one, 3-acetoxy-	Steroid	C ₃₁ H ₅₀ O ₃	470	2.95
8	37.56	Rhodoxanthin	Isoprenoid	C ₄₀ H ₅₀ O ₂	562	4.09
9	38.06	Cyclotrisiloxane, hexaphenyl-	Cyclohexyl siloxane	C ₃₆ H ₃₀ O ₃ Si ₃	594	2.75
10	38.38	Cyclotrisiloxane,2,4,6-trimethyl-2,4,6-triphenyl-	Silyl compound	C ₂₁ H ₂₄ O ₃ Si ₃	408	3.99
11	38.69	Astaxanthin	Xanthin	C ₄₀ H ₅₂ O ₄	596	5.08
12	39.53	Cholest-4-en-3-one	Steroid	C ₂₇ H ₄₄ O	384	5.07
13	40.02	(1H)-Pyrrole-3-propanoic acid, 2-ethoxycarbonylmethyl-4-ethoxycarbonylmethyl]-5,5'-methylene, bis-,diethyl ester	Ester	C ₃₃ H ₄₆ N ₂ O ₁₂	662	5.82
14	40.38	Rubixanthin acetate	Xanthin	C ₄₂ H ₅₈ O ₂	594	5.82
15	42.19	Ajmaline, bis(trimethylsilyl)-	Silyl Fused Heterocyclic	C ₂₆ H ₄₂ N ₂ O ₂ Si ₂	470	7.68

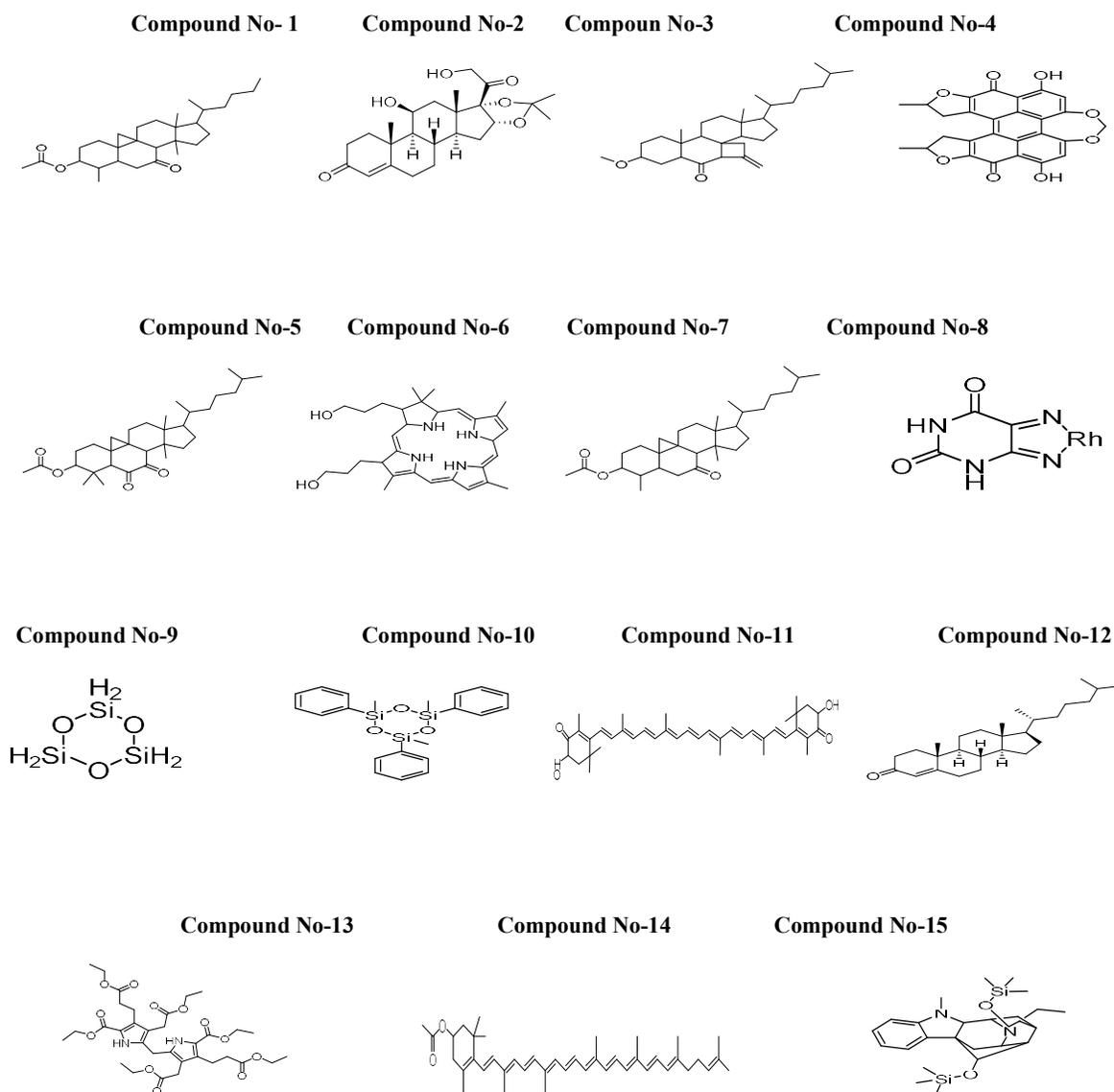


Figure 1: Structure of Chemical constituents of methanolic extract of *G. asiaticus* Wild by GC-MS study

Table 2: Chemical composition of *Lactuca runcinata* DC methanolic extract by GC-MS [5]

Compound No.	Retention time	Compound Name	Compound Nature	Molecular formula	Molecular weight	Peak Area (%)
1	3.13	Carbetapentane	Ester	C ₂₀ H ₃₁ NO ₃	333	0.45
2	8.10	2-Propenoic acid, 2-methylpropyl ester	Ester	C ₇ H ₁₂ O ₂	128	0.83
3	14.34	Bornyl Acetate	Ester	C ₁₂ H ₂₀ O ₂	196	0.89
4	17.77	Acetic acid, tricyclo[4.4.0.0(3,8)]dec-9-en-4-yl ester	Alcohol	C ₁₂ H ₁₆ O ₂	192	1.24
5	20.60	Methanone(1-hydroxycyclohexyl) phenyl	Ketone	C ₁₃ H ₁₆ O ₂	204	3.28
6	23.00	1(3H)-Isobenzofuranone, 3-ethoxy	Ketone	C ₁₀ H ₁₀ O ₃	178	7.79
7	29.06	4-Hydroxy-6-(4-methoxyphenyl)-2-pyranone	Ketone	C ₁₂ H ₁₀ O ₄	218	0.62
8	33.40	1-Benzoyl-3-(4'-nitrophenyl)pyrrolo [2,1-a]phthalazine	Ketone	C ₂₄ H ₁₅ N ₃ O ₃	393	0.64
9	33.82	Pyridine-3-carboxamide, 2,4,6-trichloro-N-(4-methoxyphenyl)-5-nitro	Amide	C ₁₃ H ₈ Cl ₃ N ₃ O ₄	375	0.55
10	34.56	1,3-Dithiole, 4-(4-hydroxyphenyl)-2-[(4-hydroxyphenyl)-1,3-dithiol-2-ylidene]	Ester	C ₁₈ H ₁₂ O ₂ S ₄	388	0.68
11	34.89	Colchifoline	Steroidal ester	C ₂₂ H ₂₅ NO ₇	415	0.63
12	36.01	Cyclohexasiloxane	Steroidal ester	C ₁₂ H ₃₆ O ₆ Si ₆	444	0.78
13	36.56	Tributyl(2-thienyl)stannane	Heterocyclic	C ₁₆ H ₃₀ SSn	374	0.72
14	36.87	3-n-Pentadecyl-2,4-dinitrophenol	Phenol	C ₂₁ H ₃₄ N ₂ O ₅	394	0.93
15	37.16	1,3-Bis(4-nitrobenzyl)-5,6-dihydrobenzo[f]quinazoline	Aromatic	C ₂₆ H ₂₀ N ₄ O ₄	452	1.54
16	38.00	1,2-Benzenedicarboxylic acid, bis(2-ethylhexyl) ester	Ester	C ₂₄ H ₃₈ O ₄	390	1.41
17	38.59	(Z)-2-Phenyl-1-(diphenylmethylsilyl)-1,4-pentadiene	Hydrocarbon	C ₂₄ H ₂₄ Si	340	2.39
18	41.66	4-[p-Bis(2-hydroxyethyl)amino]phenyl-1-bromoisoquinoline	Isoquinoline	C ₁₉ H ₁₉ BrN ₂ O ₂	386	0.54
19	43.20	Ergost-25-ene-3,6-dione, 5,12-dihydroxy-, (5 α ,12 α)	Steroid	C ₂₈ H ₄₄ O ₄	444	10.46
20	43.84	Lup-20(29)-en-3-ol, acetate, (3 α)-	Steroidal ester	C ₃₂ H ₅₂ O ₂	468	15.11
21	45.13	E-Ethyl (Z)-3-(4-Acetylphenylthio) cinnamate	Ester	C ₁₉ H ₁₈ O ₃ S	326	33.01

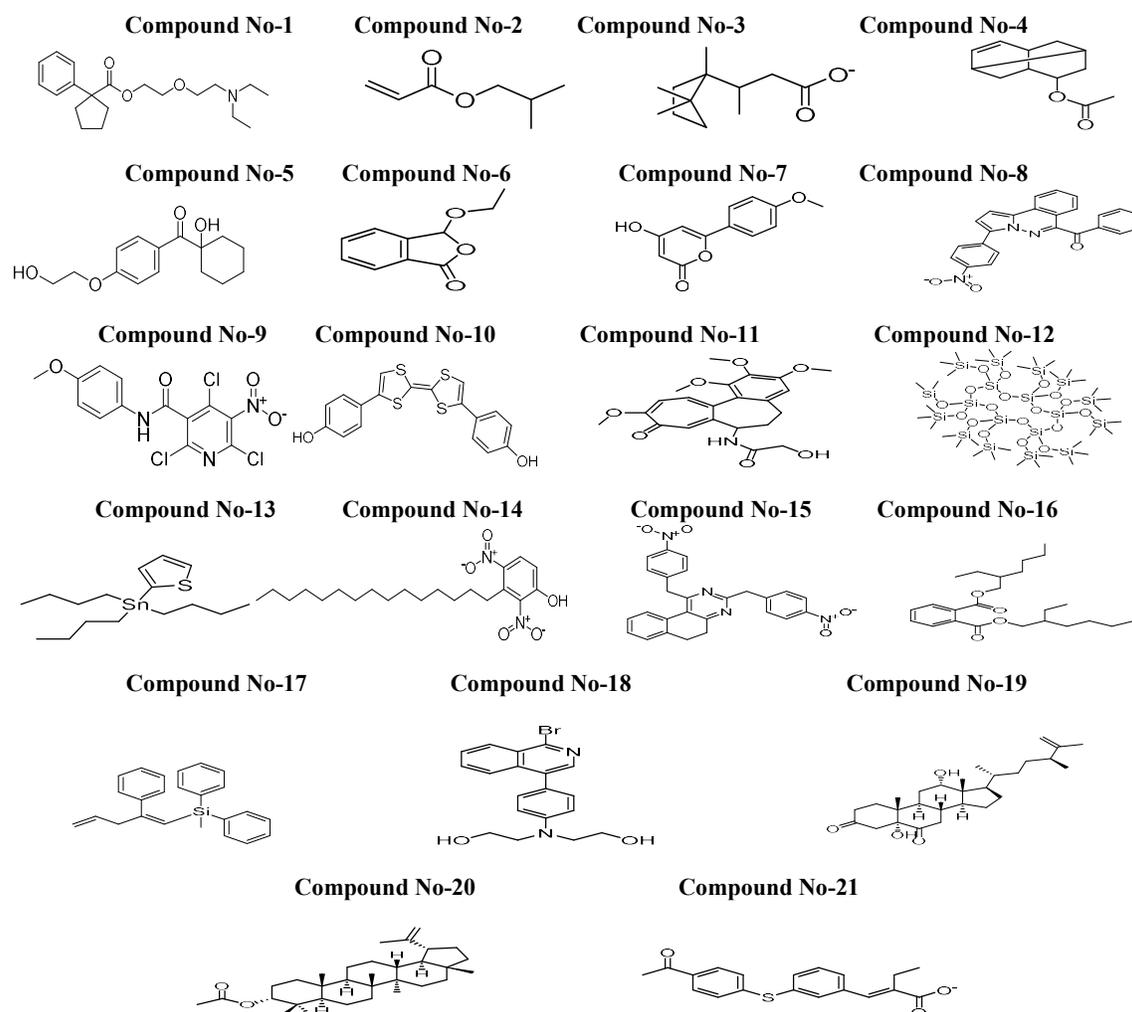


Figure 2: Structure of Chemical constituents of methanolic extract of *Lactuca runcinata* DC by GC-MS study

PHARMACOLOGICAL PROPERTIES:

The following biological activities have been reported from the extracts of *Gyrocarpus asiaticus* Willd and *Lactuca runcinata* DC: antibacterial, anthelmintic, cardiotoxic, antioxidant, cytotoxic (anti-cancer), anti-diabetic, hypolipidaemic and hepatoprotective activities.

Antibacterial activity:

Kanthal *et al.* [12-17] evaluated the antibacterial potential of the aqueous and

methanolic extracts (50, 100, 200 & 400 mg/ml) of *Gyrocarpus asiaticus* against *Staphylococcus aureus*, *Escherichia coli*, *Salmonella typhi*, *Salmonella paratyphi*, *Pseudomonas mirebelis*, *Pseudomonas auroginosa* and *Klebsiella pneumoni* using disc diffusion method with Ciprofloxacin (5 µg/ml) as positive control. The aqueous and methanol extracts showed activities against all tested bacteria with the exception of *Klebsiella pneumoni* with minimum

inhibitory concentration (MIC) values ranging from 0.039 mg/ml to 0.32 mg/ml and minimum bactericidal concentration (MBC) values ranging from 0.16 mg/ml to 0.64 mg/ml, respectively [12-17].

Kanthal *et al.* [18] evaluated the antibacterial activity of the methanolic extracts (50, 100, 200 & 400 mg/ml) of aerial parts of *Lactuca runcinata* against *Staphylococcus aureus*, *Escherichia coli*, *Salmonella typhi*, *Salmonella paratyphi*, *Pseudomonas mirebelis*, *Pseudomonas auroginosa* and *Klebsiella pneumoni* using disc diffusion method with Ciprofloxacin (5 µg/ml) as positive control. The methanol extracts exhibited activities against all tested bacteria with the exception of *Salmonella typhi* with minimum inhibitory concentration (MIC) values ranging from 0.04 mg/ml to 0.64 mg/ml and minimum bactericidal concentration (MBC) values ranging from 0.16 mg/ml to 1.28 mg/ml [18].

Anthelmintic activity:

In 2013, a study on anthelmintic activity of extracts (25, 50, 100 mg/ml) of aerial parts of *Gyrocarpus asiaticus* Willd and *Lactuca runcinata* DC against *Pheritima posthuma* with Albendazole (25, 50, 100 mg/ml) as positive control was carried out by Kanthal *et al.* [4, 19, 20] In this study, extracts were exhibited anthelmintic activities against

Pheritima posthuma with paralysis time ranging from 34.86±3.03 to 38±4.38 minutes for highest concentration and death time ranging from 66.2±1.75 to 76.6±3.26 minutes for highest concentration (100 mg/ml) but the standard drug Albendazole showed the least paralysis time of 31.66±0.88 min. and death time of 63.83±4.16 min. The study established that *Lactuca runcinata* DC was a more effective against *Pheritima posthuma* as compared with *Gyrocarpus asiaticus* Willd [4, 19, 20].

Cardiotonic activity:

Kanthal *et al.* [21-23] evaluated the cardiotonic activity of methanolic extract (1.0 & 2.0 mg/ml) of *Gyrocarpus asiaticus* and *Lactuca runcinata* on isolated frog heart with cardiotonic drug digoxin (0.25 & 0.5 mg/ml) as the positive control. The present study was observed that better increase of force of contraction (positive inotropic effect) and better decrease of heart rate (negative chronotropic effect) by using isolated frog heart perfusion technique. The extracts exhibited significant cardiotonic property and wide therapeutic index as compared to cardiac glycosides.

Antioxidant activity:

Vithya *et al.* [24] reported the antioxidant activities of methanolic extract of bark of *Gyrocarpus asiaticus* using DPPH (2, 2-

diphenyl-1-picrylhydrazyl) and ABTS (2, 2'-azino-bis (3-ethylbenzthiazoline -6-sulphonic acid) scavenging assay methods. The extracts exhibited very good antioxidant effect which was compared with standard Ascorbic acid (positive control) in DPPH method as compared to the ABTS method [24].

Korade and Deokhule [25] performed the antioxidant activity, total phenolics & nutritive values of the methanol, butanol, ethyl acetate and chloroform extracts of *Lactuca runcinata*. The results obtained from the study provided sufficient evidence that *Lactuca runcinata* (methanolic extract) may be potential rich source for natural antioxidant remedies and it can also be used for food and cosmetic related products.

Cytotoxic activity:

Vithya et al. [26] evaluated the cytotoxicity activities of methanolic extract of *Gyrocarpus asiaticus* bark against the human cervical cancer cell lines (HeLa) and human colorectal adenocarcinoma cell lines (HCT116). Cytotoxic activity of these extracts was done using MTT [3-(4, 5-dimethyl thiazol-2-yl)-2, 5-diphenyl tetrazolium bromide] assay. The result showed an IC₅₀ value of 31.59 µg/ml and 30.24 µg/ml respectively in HeLa and HCT116 cell lines. *Gyrocarpus asiaticus*

extract exhibited better cytotoxicity against both the human cancer cells [26].

In 2014, Kanthal et al. [27-38] carried out the *in vitro* studies to evaluate the cytotoxic (anti-cancer) potential of the methanolic extracts of *Gyrocarpus asiaticus* and *Lactuca runcinata* against MCF-7 (Human breast adenocarcinoma), HepG2 (Human liver carcinoma), HeLa (Human cervix carcinoma) and A-549 (Human Lung adenocarcinoma epithelial) cell lines. Screening of these extracts was done using MTT [3-(4, 5-dimethyl thiazol-2-yl)-2, 5-diphenyl tetrazolium bromide] assay. *Gyrocarpus asiaticus* exhibited better values of growth inhibition than *Lactuca runcinata* and altered the cellular morphology (for 1000 µg/ml concentration) against four cell lines. *Gyrocarpus asiaticus* extract showed significantly higher cytotoxicity against HeLa cells with an IC₅₀ of 113.33±0.5 µg/ml than in HepG2 cells with an IC₅₀ of 116.67±0.5 µg/ml and lowest cytotoxic effect against A-549 cells with an IC₅₀ of 370 µg/ml than in MCF-7 cells with an IC₅₀ of 380 µg/ml. However, no cytotoxic effect was observed in *Lactuca runcinata* with an IC₅₀ of >1000 µg/ml against four cell lines.

Anti-diabetic Activity:

Yelchuri and Yajaman [39] reported the anti-diabetic activity of bark of *Gyrocarpus*

asiaticus Willd against streptozocin induced diabetes in rats. The ethanolic extract at the dose of 400 mg/kg body weight exhibited significant anti-diabetic activity as compare with the standard drug Glibenclamide (positive control). Thus, *Gyrocarpus asiaticus* could be established as an anti-diabetes agent from natural sources.

Hypolipidaemic activity:

In 2015, Iswarya *et al.* [40] reported that hypolipidemic effect of ethanolic extract from whole plant of *Lactuca runcinata* in rats. The study exhibited that the extract significantly reduced plasma lipid and lipoprotein profile which was important part for reducing of atherogenic index and cardiac risk ratio. It also significantly reduced the tissues free cholesterol, ester cholesterol, triglycerides and phospholipids. So, *Lactuca runcinata* plant can be useful for the treatment of hyperlipidaemia disease.

Hepatoprotective activity:

In 2019, Moharana *et al.* [41] evaluated the hepatoprotective effect of *Gyrocarpus asiaticus* bark by using paracetamol induced hepatotoxicity in Zebra Fish. The extract showed very good reduction in alanine transferase (ALT) for the confirmation of histopathological analysis. The study revealed that bark of *Gyrocarpus asiaticus* possess hepatoprotective activity against

paracetamol induced hepatic damage in zebra fish.

Kanthal *et al.* [42] carried out the carbon tetra chloride induced hepatotoxicity in rats to evaluate the hepatoprotective potential of aerial parts of *Gyrocarpus asiaticus* and *Lactuca runcinata*. The present study showed that CCl₄ causes increase in the levels of various biochemical parameters but both the plant extracts and silymarin (positive control) produce reduction levels of various biochemical parameters (SGOT:serum glutamate oxalate transaminase, SGPT: serum glutamate pyruvate transaminase, ALKP: alkaline phosphatase and TB: total bilirubin). From the study it is evident that *Gyrocarpus asiaticus* methanolic extract have potent hepatoprotective property as compare to *Lactuca runcinata* methanolic extract due to may be presence of phenols and flavonoids.

Toxicity studies:

In 2017, Kanthal *et al.* reported the toxicological studies of methanolic extracts of *Gyrocarpus asiaticus* and *Lactuca runcinata* in female non-pregnant albino mice. In this study acute toxicity study was carried out on the aerial parts of the plants. From the result of the toxicity study the methanolic extracts of *Gyrocarpus asiaticus* and *Lactuca runcinata* were found to be non-

toxic in mice when administered orally in doses upto 5000 mg/kg. No mortality of the animals was observed during experimental periods [42].

CONCLUSION:

From the review of the present work, it was concluded that the study summarizes the phytochemistry and pharmacological properties of *Gyrocarpus asiaticus* Willd and *Lactuca runcinata* DC. Both the plants have been used in the treatment of various diseases and reported to have antibacterial, anthelmintic, cardiogenic, antioxidant, cytotoxic, anti-diabetic, hypolipidaemic and hepatoprotective activities but still today, *Lactuca runcinata* and *Gyrocarpus asiaticus* have not evaluated for anti-diabetic and hypolipidaemic activity, respectively. Further research should be focus on other pharmacological activities by using different parts and different solvent with *Lactuca runcinata* and *Gyrocarpus asiaticus* plants for the treatment of other diseases.

CONFLICT OF INTEREST:

The authors declare that there is no conflict of interests regarding the publication of this article.

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