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Phyto Medicinal Compounds from *Urginea indica* Kunth: A Synthetic Drugs Potential Alternative

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Authors' contributions

This work was carried out in collaboration between all the authors. Author RP designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors BJ and PNP managed the analyses of the study and the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

Urginea indica belongs to Lilliaceae family the analysis of bioactive compounds through GCMS analysis revealed the presence of various phytosterols, organic acids, esters, phenoles and ketones have identified. The 36 compounds identified included hepato protective and dermatogenic 9,12,15-Octadecatrienoic acid 18.02%, anti cancerous and anti glycemic. Stigmasterol 17.35%, and Squalene 3.22%, antimicrobial and Hypocholesterolemic n-Hexadecanoic acid 14.26%, Antimicrobial, Diuretic Phytol 10.63%, anti carcinogenic pyrogallol 10.40%, anti atherosclerotic 9,12 -Octadecadienoic acid 6.44%, Octadecanoic acid 3.36% were identified. It was also reported to have various alkaloids, flavonoid glycosides, anti oxidants, saponins, proteins and carbohydrate. The identified compounds gave reason to various traditional medicines from *U. indica* and a key to new medicines.

Keywords: Urginea indica; phytosterols; stigmasterol; squalene and hypocholesterolemic.

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1. INTRODUCTION

The summation of ethno botanical resources, folklore practices and traditional medicinal system along with modern bio chemical analysis techniques can help the 21st century to overcome the dilemma about the ever increasing disease threats. Nowadays the pharmaceutical industry is more and more dependent on natural products and there is no wonder in the fact that the 25% drugs now in use were derived from plant products [1,2]. The study of phytochemicals present in various plants not only lead to the discovery of important medicines but also resulted in the identification of high value industrial products [3].

Urginea indica belongs to Lilliaceae family is a wonder plant because of its important medicinal properties alone. It is rare and endemic to India, Africa, and Mediterranean regions [4]. *U. indica* is a herbaceous perennial geophytes with pear shaped bulbs and transparent outer scales with a little brown or yellowish enclosing each other completely and fibrous roots of six to ten inches of length arising from the base of the bulb. Three fourth of the bulb is usually immersed in soil [5]. *U. indica* in various formulations and dosages as a remedy for Skin disorders, Worm infestation, Diarrhea, Cardiac disorders, inflammation, Chronic rhinitis, Chronic cough, Chronic pulmonary disorders, Respiratory disease, cardiotonic, Renal failure, Chronic renal failure, Amenorrhea, Dysmenorrheal and Itching. It is useful in cancer [6]. The extracts from *U. indica* bulb are very useful against fungal diseases, bronchitis and asthma [7]. The bulb of *Urginea indica* is used against Arthritis [8]. The various anti oxidants present in the plant helps in the removal of free radicals from our body, since these free radicals are carcinogenic in nature thus *Urginea indica* has a remarkable anti carcinomic property too [9]. Besides it has abortifacient effects and affects on menstrual cycle traditionally it is a medicine for jaundice [6]. Three novel flavonoid glycosides, 5,6-dimethyoxy-3', 4''- dioxymethylene- 7- O- (6''-beta- D- glucopyranosyl-beta-D-glucopyranosyl) flavanone, 5, 4'-dihydroxy-3-O-alpha-L-rhamnopyranosyl-6-C-glucopyranosyl-7-O-(6''-para-coumaroyl-beta-D-glucopyranosyl) flavone and 5, 4'-dihydroxy-3-O-(2'''' - beta-glucopyranosyl-alpha-L-rhamnopyranosyl)- 6- C-glucopyranosyl- 7- O- (6''- para-coumaroyl- beta-D- glucopyranosyl) flavone were isolated from the 1-butanol soluble fraction of the bulbs of the plant *Urginea indica* [10]. The preliminary phyto chemical analysis shows it contains primary and secondary metabolites such as carbohydrate, proteins, alkaloids, phenolic compounds, saponins. The extract was found to possess anti-bacterial activity in *E. coli, S. aureus and P. aeruginosa* [9].

2. METHODS

2.1 Preparation of Extract

The whole plant of *Urginea indica* were shade dried and pulverized well. About 20 grams of the powered whole plant were soaked in 100 ml of acetone it was left for 24 hrs and filtered through Whatmann (No 1) filter paper and the residues were removed, extracts were concentrated using a rotary evaporator at a maximum temperature of 45°C and stored in a vial for further GC-MS analysis. The GC – MS analysis was carried out using a Clarus 500 Perkin – Elmer (Auto system XL) Gas Chromatograph equipped and coupled to a mass detector Turbo mass gold – Perkin Elmer Turbo mass 5.2 spectrometer with an Elite– 5MS (5% Diphenyl / 95% Dimethyl poly siloxane), 30m x 0.25 µm DF of capillary column. The instrument was set to an initial temperature of 110°C, and maintained at this temperature for 2 min. At the end of this period the oven temperature was raised to 280°C, at the rate of an increase of 5°C /min, and maintained for 9 min. Injection port temperature was ensured as 200°C and Helium flow rate as one ml/min. The ionization voltage was 70eV. The samples were injected in split mode as 10:1. Mass spectral scan range was set at 45-450 (m/z).Using computer searches on a NIST Version –Year 2011 were used MS data library and comparing the spectrum obtained through GC – MS compounds present in the plants sample were identified.

3. RESULTS

The modern technologies and discoveries have an advantage over past insufficiencies. This is an attempt to identify the bio active compounds which are responsible for the medicinal properties in *U. indica*. The thirty six different phyto chemicals identified through GC-MS analysis provide explanation to the various medicinal properties that already known and being practiced and it also opens new horizons in the field of isolation of compounds with potential medicinal properties. The important phytochemicals identified along with their bioactive uses were listed in Table 1. The chromatogram is displayed as Fig. 1.

Table 1. Phyto-components identified in ethanol extracts of bulb of *Urginea indica* Kunth by GCMS

Sl no.	RT	Compound name	Molecular formula	Molecular weight	Peak area (%)	Medicinal uses*
1	28.745	9,12,15-Octadecatrienoic acid	$C_{18}H_{30}O_2$	278	18.02	Anti inflammatory, Insectifuge Hypocholesterolemic, Cancer preventive, Nematicide, Hepatoprotective, Insectifuge, Antihistaminic, Antieczemic, Antiacne, 5-Alpha reductase inhibitor, Antiandrogenic, Antiarthritic, Anticoronary
2	46.984	Stigmasterol	$C_{29}H_{48}O$	412	17.35	useful in prevention of certain cancers, including ovarian, prostate, breast, and colon cancers. antioxidant,hypoglycemic and thyroid inhibiting properties inhibit the absorption of cholesterol and lower serum cholesterol anti-HIV reverse transcriptase,
3	26.394	n-Hexadecanoic acid	$C_{16}H_{32}O_2$	256	14.26	Antioxidant, Hypocholesterolemic Nematicide, Pesticide, Lubricant, Antiandrogenic, Flavor, Hemolytic inhibitor
4	28.356	2-HEXADECEN-1-OL, 3,7,11,15-TETRAMETHYL-,	$C_{20}H_{40}O$	296	10.63	Anticancer, Anti-inflammatory, Antimicrobial, Diuretic
5	12.163	2-FURANCARBOXALDEHYDE, 5-(HYDROXYMETHYL)- $$ 2-FURALDEHYDE, 5-(HYDROXYMETHYL)- $$ 2-FURALDEH	$C_6H_6O_3$	126	10.40	Anti carcinogenic
6	28.653	9,12-Octadecadienoic acid	$C_{18}H_{32}O_2$	280	6.44	Antiinflammatory, Nematicide, Insectifuge, Hypocholesterolemic, Cancer preventive, Hepatoprotective, Antihistaminic, Antiacne, Antiarthritic, Antieczemic,
7	28.961	Octadecanoic acid	$C_{18}H_{36}O_2$	284	3.36	antiviral and anti-inflammatory activities to cure skin lesions Antioxidant, hypocholesterolemic nematicide, pesticide, anti androgenic,flavor, hemolytic, 5-alpha reductase inhibitor
8	38.810	2,6,10,14,18,22-Tetracosahexaene, 2,6,10,15,19,23-hexamethyl	$C_{30}H_{50}$	410	3.22	Anticancer Antimicrobial Antioxidant Chemopreventive Pesticide Anti- tumor Sunscreen

9	46.136	ergost-5-en-3-ol,	$C_{28}H_{48}O$	400	3.19	Antimicrobial Antiinflammatory Anticancer Diuretic Antiasthma Antiarthritic Antioxidant, Vasodilator ,Anti tumor, Analgesic,Hepatoprotective, Anticataract, Antidiabetic
10	24.456	2,6,10-trimethyl,14-ethylene-14-pentadecne $$ neophytadiene	$C_{20}H_{38}$	278	2.34	antipyretic, analgesic, and anti-inflammatory, antimicrobial, antioxidant
11	9.920	3-Hexen-2-one, 3,4-dimethyl- $$ (3E)-3,4-Dimethyl-3-hexen-2-one	$C_8H_{14}O$	126	1.74	protease inhibitors in the treatment of virus infection.
12	43.687	Cholesterol	$C_{27}H_{46}O$	386	1.64	Helps in osteoblastic differentiation
13	23.139	Tetradecanoic acid	$C_{14}H_{28}O_2$	228	1.06	used in cosmetic and topical medicinal preparations where good absorption through the skin is desired
14	25.799	Hexadecanoic acid, methyl ester	$C_{17}H_{34}O_2$	270	1.05	Antioxidant, Flavor, Hypocholesterolemic Nematicide, Pesticide, Lubricant, Antiandrogenic, Hemolytic, 5-Alpha reductase inhibitor
15	10.785	4H-Pyran-4-one, 2,3-dihydro-3,5-dihydroxy-6-methyl- $$ 3,5-Dihydroxy-6-methyl-2,3-dihydro-4H-pyran-4-one	$C_6H_8O_4$	144	0.93	dermatologic agent use to cure of psoriasis and skin diseases
16	18.633	Dodecanoic acid	$C_{12}H_{24}O_2$	200	0.63	dermatologic agent against achne, anti atherosclerotic
17	17.081	4-(3,5-DIMETHYL-1H-PYRAZOL-1-YL)-4-OXO-1-BUTANOL $$ BUTAN-1-ONE, 4-HYDROXY-1-(3,5-DIMETHYL-1-PYRAZO	$C_9H_{14}N_2O_2$	182	0.61	No activity reported
18	30.103	14-.BETA.-H-PREGNA	$C_{21}H_{36}$	288	0.50	for the prevention and treatment of diabetic retinopathy
19	11.371	1-Heptafluorobutyryloxydecane	$C_{14}H_{21}F_7O_2$	354	0.45	No activity reported
20	41.801	STIGMASTA-4,6,22-TRIEN-3-YL ACETATE	$C_{31}H_{48}O_2$	452	0.25	No activity reported
21	24.562	2-PENTADECANONE, 6,10,14-TRIMETHYL-	$C_{18}H_{36}O$	268	0.23	No activity reported
22	16.117	4-Hydroxy-.beta.-ionone $$ (3E)-4-(4-Hydroxy-2,6,6-trimethyl-1-cyclohexen-1-yl)-3-buten-2-one	$C_{13}H_{20}O_2$	208	0.21	prevention or treatment of, for example, a proliferative disorder, e.g., cancer, or symptom

23	31.266	ICOSANOIC ACID	$C_{20}H_{40}O_2$	312	0.18	No activity reported
24	31.202	4,8,12,16-Tetramethylheptadecan-4-olide	$C_{21}H_{40}O_2$	324	0.17	No activity reported
25	7.841	2-[2-(2-Butoxyethoxy)ethoxy]ethoxy-trimethylsilane	$C_{13}H_{30}O_4Si$	278	0.16	No activity reported
26	33.339	Hexadecanoic acid, 2-hydroxy-1-(hydroxymethyl)ethyl ester	$C_{19}H_{38}O_4$	330	0.16	No activity reported
27	42.264	5.beta.-Cholestan-3.alpha.-ol, methyl ether	$C_{28}H_{50}O$	402	0.15	No activity reported
28	21.867	1,3-Phenylenediacetic acid	$C_{10}H_{10}O_4$	194	0.13	Antidiabetic, Antihyper glycemic, skin protctive growth stimulant brain enhancer.
29	33.067	PENTACOSANE	$C_{25}H_{52}$	352	0.13	No activity reported
30	24.853	3,7,11,15-Tetramethyl-2-hexadecen-1-ol	$C_{20}H_{40}O$	296	0.11	Antimicrobial Anti inflammatory Anticancer Diuretic
31	30.819	Heneicosanoic acid, methyl ester	$C_{22}H_{44}O_2$	340	0.09	anti-inflammatory and anti-proliferative
32	32.129	NEOPHYTADIENE	$C_{20}H_{38}$	278	0.07	No activity reported
33	33.607	Oxirane, hexadecyl-	$C_{18}H_{36}O$	268	0.06	No activity reported
34	29.599	2,6,10-TRIMETHYL,14-ETHYLENE-14-PENTADECNE	$C_{20}H_{38}$	278	0.04	muscle relaxant
35	30.483	1-(2-DIFLUOROMETHOXY-PHENYL)-3-PHENYL-THIOUREA	$C_{14}H_{12}F_2N_2OS$	294	0.04	No activity reported
36	31.582	2,6,10-TRIMETHYL,14-ETHYLENE-14-PENTADECNE $$ NEOPHYTADIENE	$C_{20}H_{38}$	278	0.00	No activity reported

** Source: Dr. Duke's phytochemical and ethnobotanical databases*

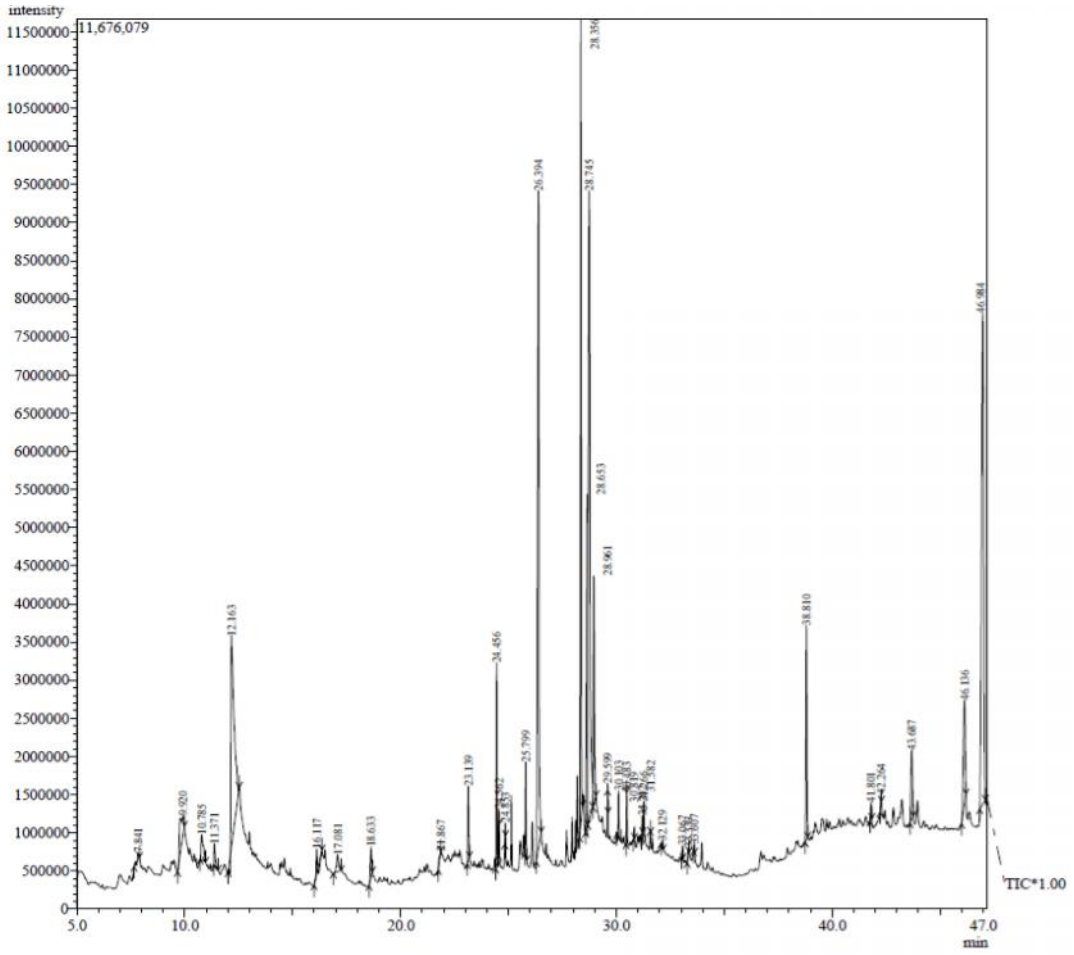

Fig. 1. GC-MS chromatogram of ethanol extract of *Urginea indica Kunth*

Among the identified compounds, 9,12,15-Octadecatrienoic acid and stigmasterol ($C_{18}H_{30}O_2$ and $C_{29}H_{48}O$) are the major with peak area 18.02% and 17.35% and retention time 28.745 and 46.984 minutes respectively. The third major compound identified was n-Hexadecanoic acid ($C_{16}H_{32}O_2$) with peak area of 14.26% and retention time 26.394 minutes. 2-HEXADECEN-1-OL, 3,7,11,15-TETRAMETHYL ($C_{20}H_{40}O$) occupies fourth position with peak area 10.63% and retention time 28.356 minutes. 2-FURALDEHYDE, 5-(HYDROXYMETHYL) ($C_6H_6O_3$) occupies the fifth position with peak area of 10.40% and RT value 12.163 minutes. In addition to this five number of compounds with bio active properties are identified from *Urginea indica* including Squalene, Dodecanoic acid, 9,12-Octadecadienoic acid good Cholesterol etc. through GC.MS analysis. The various compounds identified through GC.MS analysis were listed in Table 1.

4. DISCUSSION

The phytosterole, stigmasterol is contributing 17.35 % of the total phyto chemical content in *U. indica*. It has significant cancer preventive properties especially in certain cancers including ovarian, prostrate, breast, and colon cancers. It also possesses potent antioxidant, hypoglycemic and thyroid inhibiting [11]. Stigmasterol is used as a precursor in the manufacture of semi synthetic progesterone, which is a female hormone that plays an important physiological role in the regulatory and tissue rebuilding mechanism related to estrogen effects, reproduction, as well as acting as an intermediate in the biosynthesis of androgens, estrogens and corticoids. Squalene is another compound which significantly found in *U. indica*. It has the unique properties to Neutralize different xenobiotics. Since it is a naturally occurring compound its intake through diet is

advisable to prevent cancer [12,13] particularly to prevent colon cancer [14,15]. Pyrogallol is a cytotoxic compound it can inhibit the growth of lung cancer cell lines. Its cytotoxic properties have little effect on human bronchial epithelial cell line [16]. Beta,-Tocopherol is also reported to have high anti oxidant property so it can act as a carcinogenic molecule scavenger. The diterpene compound phytol showed significant antimicrobial properties against many bacterial strains [17]. Phytol has also reported with anti cancer property. Phytol constitute a promising novel class of pharmaceuticals for the treatment of rheumatoid arthritis and possibly other chronic inflammatory diseases [18]. Phytol is a key acyclic diterpene alcohol that is a precursor for vitamins E and K [19]. 9, 12 - Octadecadienoic acid (Z, Z) or Linolenic acid present in *U.indica* is an essential fatty acid for humans. It cannot be synthesized in our body. The intake of linolenic acid (or omega 3fatty acid) can reduce cardio vascular diseases by preventing arrhythmias that can lead to sudden cardiac death. It can also reduce the risk of thrombosis formation. It is also very effective in promoting vascular endothelial functions and there by helps in reducing atherosclerotic plaque formation. 9,12,15-Octadecatrienoic acid and 9,12 Octa decadienoic acid reported anti inflammatory property [20]. Both of these compounds have capacity to protect liver. That is why *U.indica* is hepato-protective in nature. 2-hexadecen-1-ol, 3,7,11,15-tetramethyl shows diuretic property and due to the presence of the particular compound makes *U. indica* as a potential medicine against many diseases such as high blood pressure, heart failure, obesity, gout edema, and many diseases associated with liver and kidney. Dodecanoic acid is effective against skin disorders acne and psoriasis [21]. Tetradecanoic acid is using in cosmetic and topical medicinal preparations where good absorption through the skin is desired. Octadecanoic acid has remarkable antiviral and anti-inflammatory activities. This property helps to cure skin lesions. It also acts as Antioxidant, hypocholesterolemic, nematicide, pesticide etc. It was reported that folic acid deficiency will lead to skin problems [22]. Dimethyl fumarate ($C_6H_8O_4$) is a ketone compound and it is using as a dermatologic agent use to cure of psoriasis and skin diseases. Preparations containing various mixtures of fumaric acid esters are prescribed for psoriasis vulgaris in several countries, in many cases for off-label use, and are regarded as safe [23]. One such preparation is enteric-coated, slow-release 'Psorinovo' (compounding pharmacy, Mierlo-Hout), in which the active agent is dimethyl fumarate and in which copper gluconate was used as an additive. Recent studies are adding more and more therapeutic uses to Dimethyl fumarate such as suppression of important leukocyte adhesion molecules, induction of pro-apoptotic pathways in T-cells, anti-angiogenic action, have been discovered. The range of new therapeutic targets reaches from multiple sclerosis to illnesses such as necrobiosis lipoidica, granuloma annulare and sarcoidosis. Experimental approaches offer promising, although preliminary, results on the treatment of cancer, malaria, chronic inflammatory lung diseases, and Huntington disease [24]. The presence of these compounds makes *Urginea indica* as a natural conditioner. 14-β-H-PREGNA is present in *Urginea indica.* It was said to have the reason for anti diabetic properties. 1,3-Phenylene diacetic acid is commonly known as ferulic acid is another anti diabetic compound present in *Urginea indica* has been documented. It can lower blood sugar level of type 1 and type 2 diabetes by enhancing insulin secretion. Therefore, ferulic acid is beneficial in type 2 diabetic and for the management of diabetic complications [25]. In the year 1980 Fragrance Journal was also reported that, it have cosmetic effect such as skin whitening by the inhibit melanin formation through competitive inhibition with tyrosine. Photo-protection against u-v rays. Antioxidant effect and the reactive oxygen species scavenging effect of ferulic acid has been reported to be similar to that of superoxide dismutase [26]. It has growth enhancement effect by stimulating the somatotrophin in pituitary gland [27]. It has good inhibitory effect of carcinogenesis of colorectal cancer and blood pressure lowering effect [28,29]. Other findings include its enhancement effects on glycogen synthesis and glucokinase activity in the liver while total cholesterol and LDL -cholesterol were decreased. It is also important for its Anti hyperglycemic action in human body [30]. Brain function enhancing effect provides neuro protection against oxidative stress and also against amyloid beta-peptides. Hence, ferulic acid may enhance learning ability and memory function [31,32].

5. CONCLUSIONS

The results of phytochemical analysis in *Urginea indica* through GCMS analysis corroborate and provide evidences for traditional medicinal practices based on ethnobotany. Definitely it will

pave way to effective medicinal formulations with the help of modern molecular study and drug docking techniques. It is also very essential to adopt scientific conservation to protect *Urginea indica* in its natural habitat. Then only its benefits will accessible to next generations. However detailed analysis and quantificational studies are required for medicine formation. Hope that such developments may happen now onwards.

CONSENT

It is not applicable.

ETHICAL APPROVAL

It is not applicable.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Williams DA, Lemke TH. Antimicrobial activity of three bioactive compounds from the stem bark of *Piper chaba* Hunter. Biosc Res. 2002;1(1):16-20.
2. Rahman A, Parvez MAK, Parvin T, Paul DK, Sattar MA. Antimicrobial activity of three bioactive compounds from the stream bark of *Piper chaba* Hunter. Biosc Res. 2004;1(1):16-20.
3. Khalequzzaman M, Gazi MMR, Das BC. Antimicrobial activities of the rhizome and leaf extracts of *Zingiber cassumunar* Roxb. Bangladesh J Genet Biotechnology. 2002;3:35-40.
4. Airy Shaw HK. A dictionary of flowering plants and freus 8th Edition Willis JS, Ed. Cambridge University press Cambridge; 1966.
5. Kameshwari, Bijul Lakshman A, Paramasivam G. Biosystematics studies on medicinal plant *Urginea indica* Kunth. Liliaceae - A Review International Journal of Pharmacy & Life Sciences. 2012;3(1): 1394-1406.
6. Kameshwari. Chemical constituents of wild onion *Urginea indica* Kunth Liliaceae. International Journal of Pharmacy & Life Sciences. 2013;4(2):2414-2420.
7. Marx J, Pretorius E, Bester MJ. Effects of *Urginea sanguine* a traditional asthma remedy, on embryo neuronal development. J Ethnopharmacol. 2006;104(3),315-21. PMID: 16242279
8. Mominur Rahman, Jakir Ahmed Chowdhury, Razibul Habib, Barun Kanti Saha, Salauddin ADM, Mohammad Kaisarul Islam. Anti-inflammatory, anti-arthritic and analgesic activity of the alcoholic extract of the plant *Urginea indica* Kunth. IJPSR. 2011;2(11):2915-2919.
9. Panduranga Murthy G, Mamtharani DR, Tejas TS, Niranjan M Suarlikerimath. Phytochemical analysis, *in vitro* anti-bacterial and antioxidant activities of wild onion sps. International Journal of Pharma and Bio Sciences. 2011;2(3):230-237.
10. Sultana N, Akter K, Nahar N, Khan MS, Mosihuzzaman M, Sohrab MH, Krohn K. Novel flavonoid glycosides from the bulbs of *Urginea indica* Kunth. Nat Prod Res. 2010;24(11):1018-26.
11. Panda S, Jafri M, Kar A, Meheta BK. Thyroid inhibitory, antiperoxidative and hypoglycemic effects of stigmasterol isolated from Buteamonosperma. Fitoterapia. 2009;80(2):123–126.
12. Smith Theresa J. Squalene: Potential chemopreventive agent. Expert Opinion on Investigational Drugs. 2000;9(8):1841–8.
13. Owen RW, Haubner R, Würtele G, Hull WE, Spiegelhalder B, Bartsch H. Olives and olive oil in cancer prevention. European Journal of Cancer Prevention. 2004;13(4):319–326.
14. Rao CV, Newmark HL, Reddy BS. Chemopreventive effect of sqalene on colon cancer. Carcinogens. 1998;19:287-297.
15. Alagammal P, Tresina S, Mohan VR. Int. J Curr. Pharmaceut.Res. 2012;4:42-44.
16. Yang CJ, Wang CS, Hung JY, Huang HW, Chia YC, Wang PH, Weng CF, Huang MS. Pyrogallol induces G2-M arrest in human lung cancer cells and inhibits tumor growth in an animal model. Lung Cancer. 2009;66:162–168.
17. Bharathy V, Maria Sumathy B, Uthayakumari F, Determination of phytocomponents by GC-MS in leaves of *Jatropha gossypifolia* L. Sci. Res. Reporter. 2012;2(3):286-290.

18. Ogunlesi M, okiei W, Ofar E, Osibote AE, Afric. J. Biotech. 2009;8:7042-7050.
19. Sathyaprabha G, Kumaravel S, Ruffina D, Praveenkumar P, J. Pharm. Res. 2010;3(12):2970-2973.
20. Peter J Jones. Clinical nutrition: 7 funtional food more than just nutrition. CMAJ. 2002;166:1555-1563.
21. Nakatsuji T, Kao MC, Fang JY, Zouboulis CC, Zhang L, Gallo RL, Huang CM. Antimicrobial property of lauric acid against *Propionibacterium acnes*: Its therapeutic potential for inflammatory acne vulgaris. The Journal of Investigative Dermatology. 2009;129(10):24808. DOI: 10.1038/jid.93
22. Shuster S, Marks J. Chanarin, folic acid deficiency in patients with skin disease. British Journal of Dermatology. 1967; 79:398–402. DOI: 10.1111/j.1365-2133.1967.tb11518
23. Reich K, Thaci D, Mrowietz U, Kamps A, Neureither M, Luger T. Efficacy and safety of fumaric acid esters in the long-term treatment of psoriasis -- A retrospective study (FUTURE). J Dtsch Dermatol Ges. 2009;7:603-611.
24. Meissner Markus, Valesky, Eva Maria, Kippenberger, Kaufmann, Roland Dimethyl fumarate - Only an anti-psoriatic medication? Journal der deutschen dermatologischen gesellschaft. 2012; 10(11):793-802 DOI: 10.1111/j.1610-0387.2012.07996
25. Nomura H. Acceleration of ferulic acid and related compounds on insulin secession. Research Report of Wakayama Industrial Technology Center. 2001;17-9.
26. Toda S, Kumura M, Ohnishi M. Effects of phenolcarboxylic acids on superoxide anion and lipid peroxidation induced by superoxide anion. Planta Medica. 1991; 57(1):8–10.
27. Gorewit RC. Pituitary and thyroid hormone responses of heifers after ferulic acid administration. J. Dairy Sci. 1983;66:624-9.
28. Mori H, Kawabata K, Yoshimi N, Tanaka T, Murakami T, Okada T, Murai H. Chemopreventive effects of ferulic acid on oral and rice germ on large bowel carcinogenesis. Anticancer Res. 1999;19: 3775-8.
29. Hudson EA, Dinh PA, Kokubun T, Simmonds MS, Gescher AC. Characterization of potentially chemopreventive phenols in extracts of brown rice that inhibit the growth of human breast and colon cancer cells. Cancer Epidemiol Biomarkers Prev. 2000;9:1163-70.
30. Ardiansyah, Ohsaki Y, Shirakawa H, Koseki T, Komai M. Novel effects of a single administration of ferulic acid on the regulation of blood pressure and the hepatic lipid metabolic profile in stroke-prone spontaneously hypertensive. J. Agric. Food Chem. 2008;56:2825-30.
31. Cheng CY, Su SY, Tang NY, Ho TY, Chiang SY, Hsieh CL. Ferulic acid provides neuro protection against oxidative stress-related apoptosis after cerebral ischemia/reperfusion injury by inhibiting ICAM-1 mRNA expression in rats. Brain Res. 2008;13:136-50.
32. Perluigi M, Joshi G, Sultana R, Calabrese V, De Marco C, Coccia R, Cini C, Butterfield DA. *In vivo* protective effects of ferulic acid ethyl ester against amyloid-beta peptide 1-42-induced oxidative stress. J. Neurosci. Res. 2006;84:418-26.

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