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Arugula- The Green Solution for Diabetics and Cholesterol

M K Shaheer*, A Finose, K M Shafi and K M Hashim

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Abstract

Eruca vesicaria sativa globally known as Arugula belongs to the family of Brassicaceae is a salad food supplement commonly used in Middle East along with the high fat content foods. In this background the current investigation thoroughly studied about the diabetics and cholesterol status of both the regions and also studied the importance of the Arugula by performing phytochemical and clinical observations.The Flavanoids/Phenolics Ratio was calculated for the plant. Nitric oxide assay and DPPH scavenging activity of the plant was calculated to determine the antioxidant potential of the plant.LCMS analysis was performed for methanol,chloroform and petroleum ether extracts of the plant and five compounds[Cynidin, Reservitol, Sorbitol, Camphene and Quercetin] having antidiabetic and anticholesterol activity was studied using PASS software.

.**Key Words:** Diabetes Mellitus, *Eruca vesicaria sativa,* F/P Ratio, PASS.

Introduction

Diabetes mellitus can be classified into two major categories: type 1 and type 2 diabetes. Of the patients who have diabetes mellitus, 85-95% suffers from type 2diabetes [1]. Currently available pharmacological agents for type 2 diabetes have a number of limitations, such as adverse effects and high rates of secondary failure. Due to these factors, diabetic patients and healthcare professionals are increasingly considering complementary and alternative approaches, including the use of medicinal herbs with anti-hyperglycemic activities [2]. Cholesterol is a chemical that can both benefit and harm the body. On the good side, cholesterol plays important roles in the structure of cells and in the production of hormones. It is possible with computer program PASS (Prediction of Activity Spectra for Substances), which predicts the biological activity spectrum for a compound on the basis of its structural formula [3].

*Corresponding author: M.K.Shaheer, Tel: +91-9388762368. E-mail: shaheer_babu3@rediffmail.com

Results and Discussion

The phenolic contents of the plant show higher values. The Flavonoids were also determined so as to sketch the F/P ration of the plant. The F/P ratio is a measurement of the capacity of the sample to convert the Phenolics to Flavonoids which are highly potent [8]. The F/P ratio of the plant was also higher which implies that this plant is highly potent [Table 1].

The pharmacological effects were also supported the fact that the plant shows higher activity. The combined nitric oxide and the DPPH assay revealed that the plant pa which the ancient ayurvedic specifies have higher activity when compared to the other parts[Table 2].

Clinical studies shows the significant variations to lowering the cholesterol and sugar values in different age groups which done at locally amoung the common people at Malappuram [Table 3].

From the liquid chromatographic and mass spectroscopic (LCMS) studies [Table 4] the plant Arugula shows five major compounds (Quercetin,

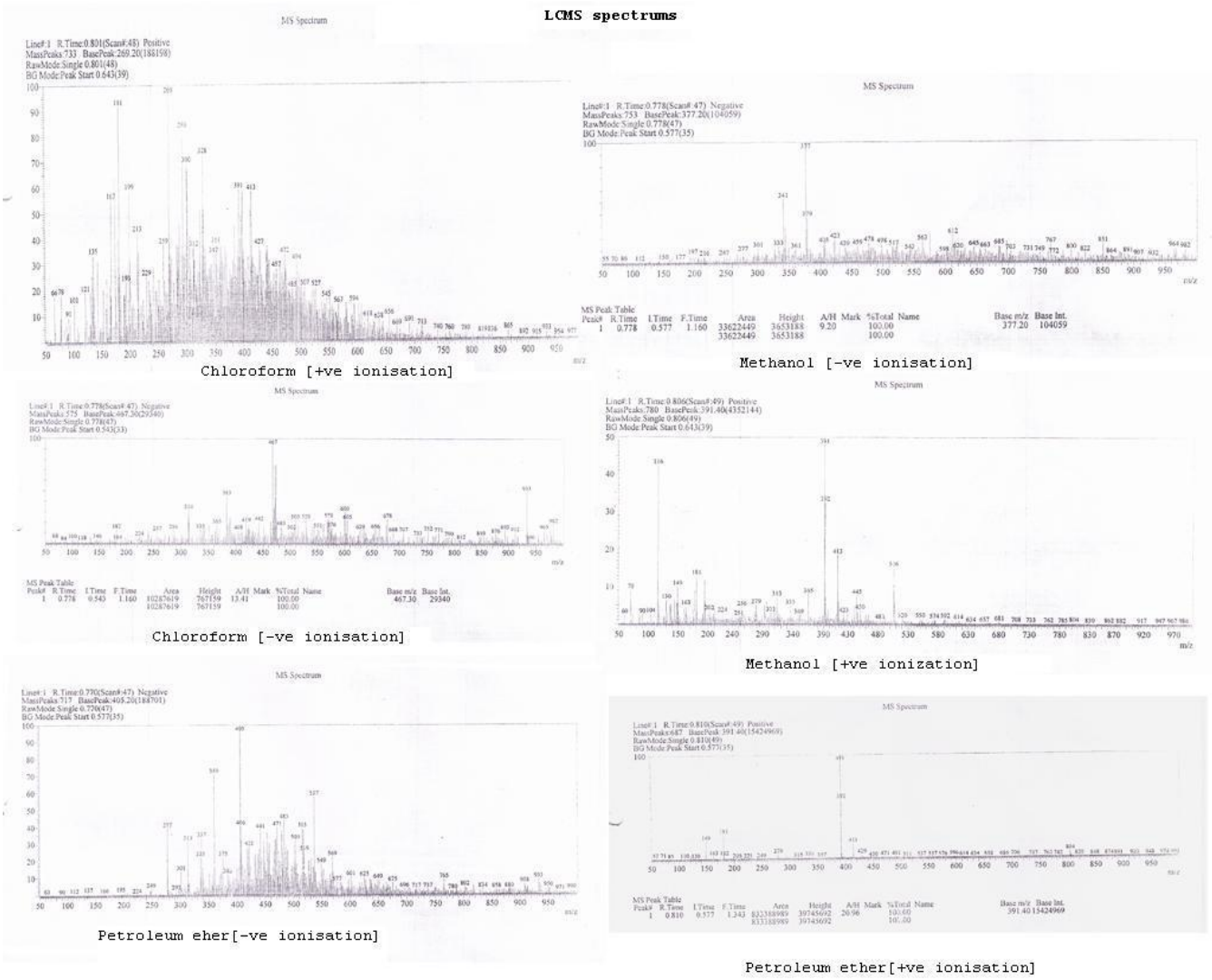

Table 4- shows the LCMS graphs of the plant

Cyanidin, Reservatrol, D-sorbitol, Camphene) which are very much effective to lowering of diabetic conditions and cholesterol also. These five major compounds were applied for the PASS prediction study to predict the biological activity of the compounds [Tables 5 to 9].

Table 1 shows F/P ratio of the plant

Phenols	Flavonoids	F/P
1.49	0.31	0.20
1.75	0.53	0.30
1.93	0.71	0.36
2.04	0.96	0.47

Table2 Results of nitric oxide assay and DPPH scavenging activity of the plant

EC50 of Nitric Oxide Assay	EC50 of DPPH Activity
36%	44%

Table3 shows the clinical parameters of different age groups

Age group	Sugar %	Cholesterol %
18-22	22%	18%
22-25	19%	12%
25-30	12%	8%
30 above	5%	3%

Table 5 shows PASS activity of Quercetin

Predicted activity of Quercetin
Membrane permeability inhibitor Membrane integrity agonist Hemostatic Vasoprotector 15-Oxoprostaglandin 13reductase inhibitor Hypokalemia Capillary fragility treatment Antioxidant CYP1A inducer Carbonyl reductase (NADPH) inhibitor Morphine 6-dehydrogenase inhibitor UDPglucuronosyltransferase substrate Antimetastatic UGT1A substrate Cytoprotectant Trans-1,2-dihydrobenzene-1,2diol dehydrogenase inhibitor TERT expression inhibitor Nitric oxide antagonist UGT1A6 substrate P-benzoquinone reductase (NADPH) inhibitor Tachycardia Chemopreventive CYP3A4 inducer Hyperthermic Emetic

Table 6 shows PASS activity of Cynidin

PASS activity of Cynidin
Ankylosing spondylitis treatment CYP2C12 substrate CYP2C9-Cys144 substrate G-Quadruplex telomerase inhibitor 2-Hydroxymuconate-semialdehyde hydrolase inhibitor Testosterone 17beta-dehydrogenase (NADP+) inhibitor Alkane 1-monooxygenase inhibitor Transferase stimulant Venombin AB inhibitor Phosphatidylcholine-retinol O-acyltransferase inhibitor Omptin inhibitor Antiseborrheic Retinal oxidase inhibitor Nitrate reductase (cytochrome) inhibitor CYP2D16 substrate Sugar-phosphatase inhibitor H+-exporting ATPase inhibitor Dehydro-L-gulonate decarboxylase inhibitor Carcinogenic, group 3 N-benzyloxycarbonylglycine hydrolase inhibitor ,Ubiquinol-cytochrome-c reductase inhibitor 27-Hydroxycholesterol 7alpha-

Table 7 shows PASS activity of reservitol

PASS activity of reservitol
semialdehyde hydrolase inhibitor ,Feruloyl esterase inhibitor VCAM1 expression inhibitor ,Testosterone 17beta-dehydrogenase (NADP+) inhibitor . Ubiquinol-cytochrome-c reductase inhibitor, All-trans-retinyl-palmitate hydrolase inhibitor,Ankylosing spondylitis treatment APOA1 expression enhancer ,Venombin AB inhibitor H+-exporting ,ATPase inhibitor CYP2C9-Cys144 substrate Carminative Fatty-acyl-CoA synthase inhibitor ,CYP2C12 substrate Transferase ,stimulant Omptin inhibitor Sugar-phosphatase inhibitor, Membrane integrity agonist ,Ribonuclease T1 inhibitor N-benzyloxycarbonylglycine hydrolase inhibitor, Alkenylglycerophosphocholine hydrolase inhibitor ,Taurine dehydrogenase inhibitor Pyruvoyltetrahydropterin synthase inhibitor, Electron-transferring-flavoprotein dehydrogenase inhibitor , Mucomembranous protector Glutathione thiolesterase inhibitor , Gamma-guanidinobutyraldehyde dehydrogenase inhibitor, Aminobutyraldehyde dehydrogenase inhibitor ,Antiinflammatory, intestinal Protoporphyrinogen oxidase inhibitor, Aldehyde dehydrogenase 1 substrate, Acylcarnitine hydrolase inhibitor

Table 8 shows PASS activity of Sorbitol

PASS activity of Sorbitol
Transferase stimulant Acrocylindropepsin inhibitor Chymosin inhibitor Saccharopepsin inhibitor Testosterone 17beta-dehydrogenase (NADP+) inhibitor Polyporopepsin inhibitor Thermopsin inhibitor Ubiquinol-cytochrome-c reductase inhibitor Cutinase inhibitor Anxiolytic Acetylesterase inhibitor Pro-opiomelanocortin converting enzyme inhibitor Sugar-phosphatase inhibitor Signal peptidase II inhibitor Acylcarnitine hydrolase inhibitor Alkylacetylglycerophosphatase inhibitor Antiseborrheic Carboxypeptidase Taq inhibitor 5 Hydroxytryptamine release stimulant Alkenylglycerophosphocholine hydrolase inhibitor Glucan 1,4-

alpha- maltotriohydrolase inhibitor Fragilysin inhibitor Gluco nate 5-dehydrogenase inhibitor 5-O-(4-coumaroyl)-D-quinate 3'- monooxygenase inhibitor Limulus clotting factor B inhi bitor CYP2J substrate CYP2J2 substrate GST A substrat e VCAM1 expression inhibitor N-formylmethionyl-peptidase inhibitor Ankylosing spondylitis treatment Cl-- transporting ATPase inhibitor Retinal oxidase inhibitor All-trans-retinyl- palmitate hydrolase inhibitor Limulus clotting factor C i nhibitor

Table 9 shows PASS activity of Camphene

PASS activity of Camphene
Transferase stimulant Phosphatase inhibitor Testost erone 17beta- dehydrogenase (NADP+) inhibitor Cardiovascular anale ptic Antimetastatic Prostaglandin E1 antagonist Acylcar nitine hydrolase inhibitor Proliferative diseases treatme nt 5-O-(4-coumaroyl)-D-quinate 3'- monooxygenase inhibitor Alkylacetylglycerophosphatas e inhibitor CYP2J substrate CYP2J2 substrate CYP2B6 i nhibitor (+)- borneol dehydrogenase inhibitor Alkenylglycerophosph ocholine hydrolase inhibitor CYP2D2 inhibitor Steroid 21- monooxygenase inhibitor Prostaglandin-E2 9- reductase inhibitor Ankylosing spondylitis treatment Ubiquinol-cytochrome-c reductase inhibitor

Materials and methods

Collection and Authentication:

Eruca vesicaria (Arugula) were collected locally and the collected plant sample was authenticated from the Taxonomy department of Uwin Life Sciences, Malappuram Kerala. The voucher specimens of the plant sample were deposited in the Herbarium of Uwin Life Sciences, Malappuram.

Phytochemical Studies

Extraction:

5 gm each of all the shade dried and powdered samples were sequentially extracted separately and quantitatively using Petroleum ether, Chloroform and Methanol for 6 hours in a soxhlet's apparatus under 65oC. The three extracts of each sample were then filtered and concentrated under dryness in a rotary evaporator under reduced pressure. These extracts were then used for the analysis

Biochemical Studies

Total Phenolic Content

Total Phenolic content of all the samples were calculated using standard protocols [4]. All the samples were performed in triplicates and the average values were plotted in the table for the calculation of the F/P ratio.

Total Flavonoid Content

Total Flavonoid content of all the samples was calculated using standard protocols [5]. All the samples were performed in triplicates and the average values were plotted in the table for the calculation of the F/P ratio.

Calculation of F/P Ratio

Flavonoids/Phenolic ratio was calculated by using the above mentioned parameters. The F/P ratio will give the measurement of the capability of the plant to convert the Phenolics to Flavonoids. As per the literature the Flavonoids are highly active in the living systems so the plants or the plant part which are capable of converting the Phenolics to Flavonoids are assumes to be highly potent.

In-Vitro Pharmacological Studies

Free radical scavenging activities of the different roots were compared by taking the capability to scavenge the nitric oxide [6] and also the super oxides which are measured as per the activity for scavenging the oxides generating by the DPPH [7]. The in-vitro activity of the specifically moved root was also noted and a chart was prepared using the data obtained. The activities were checked using nitric oxide scavenging activity and DPPH assay. The EC50 were calculated and the efficiency of all the parts was determined.

Conclusion

All the results for the above mentioned parameter revealed that the Arugula is a highly potent anti-diabetic and anti-cholesterol plant as it contains a number of highly potent molecules. The biochemical parameter F/P ratio was also calculated and a higher value shows the efficacy of the plant to convert the Phenolics to Flavonoids. The clinical trials were also revealed that this plant possesses the capacity to lower the blood

glucose and cholesterol level by different mode of actions for all the age groups. The PASS prediction studies also supported the above fact as the compounds present in the plant have a variety of mode of actions for lowering the sugar and cholesterol level in the blood.

It can be very well conclude that the reason for the healthy status of the Middle East community is the usage of the fresh plant Arugula as salad along with their food. So as a research outcome of this work we recommend the entire human trace to use the plant along with their routine food. Considering the potential of the plant steps should be taken to promote the cultivation of the plant on a large scale to create a cholesterol and diabetic free community. By promoting the cultivation and popularization of Arugula in Kerala, the economic status can be improved significantly as the plant is easily growing in Kerala condition.

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