

Coriander: Carminative Activity

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ABSTRACT

The aim of this article to present a concise review on the morphology ,macroscopic and microscopic character, chemical constituents, medicinal uses, toxic effect, pharmacological activities and phytochemistry of coriander. In this study, the ethnopharmacological review of coriander was carried out aimed at providing a detailed précis of the botany, ethnomedicinal uses, pharmacological activities and chemical composition of the species coriander. However,our intention is to update the pharmacological current activity f coriander and their industrial uses.

Keyword:- Carminative, Coriander, Activity, Formulation, Disease, Action

I. INTRODUCTION

Introduction of carminative and gastrointestinal regulators.

Carminative

Carminative: Associate in Nursing agent that stops or relieves flatulence (gas within the gi tract) and, in infants, might facilitate within the treatment of intestinal colic. The origin of the word "carminative" is especially curious. it absolutely was borrowed from the French carminatif , carminative. just about all English-language dictionaries state that the French took the word from the Latin carminare, to card wool. However, arevered French wordbook lupus erythematosus Petit parliamentarian indicates that carminare meant nettoyer, to cleanse. The confusion seems to stem from the very fact that to card wool was to cleanse it. Thus, a carminative cleanses the bowels OR square measure usually mixtures of essential oils and flavourer spices with a convention in Carminatives people drugs for this use.

Some examples for oils and spices with carminative actions are:

Angelica
Ajwain
Aniseed
Asafoetida
Basil
Calamus
Caraway
Cardamom
Cinnamon
Coriander
Oregano
Parsley
Pepper
Pennyroyal
Peppermint
Rosemary

Classification:-

ANTI-FOAMING AGENTS
Simethicone

ENZYME-BASED DIETARY SUPPLEMENTS

Beano
Lactase (brand Lactaid)
Marmite flavourer
ANTIFLATULENTS

Epazote is claimed to own anti-flatulent properties. Asafoetida reduces the expansion of autochthonic microflora within the gut thereby reducing flatulence.

In detail :-

Simethicone is AN anti-foaming agent used as Carminative, to scale back bloating, discomfort or pain caused by excessive gas. Beano is AN enzyme-based dietary supplement that's wont to scale back gas within the alimentary tract, thereby rising digestion and reducing bloating, discomfort, and flatulence caused by gas. It contains the accelerator alpha-galactosidase (aGAL). it absolutely was introduced as a liquid, however that has been out of print and it's currently out there solely as tablets and strawberry-flavored "Meltaways".

Lactase is AN accelerator created by

several organisms. it's placed within the brush border of the tiny bowel of humans and alternative mammals.

Lactase is essential to the complete digestion of whole milk; it breaks down lactose, a sugar which gives milk its sweetness. Lacking lactase, a person consuming dairy products may experience the symptoms of lactose intolerance.

Lactase can be purchased as a food supplement, and is added to milk to produce "lactose-free" milk products.

Dysphania ambrosioides, erstwhile Chenopodium ambrosioides, referred to as American wormseed, Jesuit's tea, Mexicantea, epazote, mastruz, or herba sanctae Mariae, is associate annual or passing perennial herb native to Central America, South America, and southern United Mexican States.

Asafoetida is that the dried latex (gum oleoresin) exuded from the stalk or faucet root of manyspecies of Ferula (F. foetida and F. assafoetida), perennial herbs growing one to one.5 m (3.3to 4.9 ft) tall. they're a part of the celery family, carrot family. It is use to alleviate abdomen gas.

Preventing gas:

Enzymes-

Back Enzyme-based dietary supplements breakdown uneatable substances and forestall these substances from reaching the big gut intact – wherever anaerobic microorganism manufacturegas. Substances uneatable by humans ar typically gift in foods related to flatulence, like beans. once these substances reach the big gut intact, they will be hard by internal organ microorganism, thereby inflicting gas production. These supplements ar typically soft on foods related to flatulence. it's vital to require the suitable catalyst with the suitable once overwhelming beans and different vegetables high in complicated carbohydrates, it's going to be useful to require a product that contains alphagalactosidase, like lotto or kombu.

Additionally, for people with genetic abnormality, taking a lactase-containing product with disaccharide containing foodstuffs might cut flatulence

Herbal inhibitors—several seasoning substances are ascertained since antiquity for reducing flatulence, notably gas from intake legumes. Cloves, nutmeg, cinnamon, and garlic ar potent in reducing gas. The efficiency of garlic will

increase once heated, whereas the efficiency of cinnamon decreases. Other spices have a lesser result in reducing gas, together with turmeric, black pepper, natural resin and ginger. Other common Indian spices= Cumin, aniseed, ajwain, and cardamom do inhibit gas production, in fact they exacerbate it significant.



FigureNo.-1CarminativeHerb

Coriander is among the foremost extremely demanded husbandry merchandise within the marketplace for aromatic herbs; the very best demand, worldwide, isto be used within the foodbusiness.

However, it's necessaryto consider that current demand within the food business isfamiliarisedtowards the consumption of prime quality merchandise and worth accessorial services, which give bigger edges. during this context, organic agricultural merchandise have full-grown in shopper demand.

Organic agriculture may be a technique that consists in reducing the utilization of agriculturalinputs like synthetic fertilizers and pesticides, additionally as genetically changed seeds and species. Instead, it depends on practices that ar compatible with the atmosphere which aim to keep up or increase soil fertility within the long run. though organic agriculture remains atiny low business (1%–2% of world food sales), its importance is growing worldwide. In Mexico, the success of organic merchandise ought to be attributed to the export market, that representsa crucial supply or financial gain for little producer.



Figure no.-2 Coriander

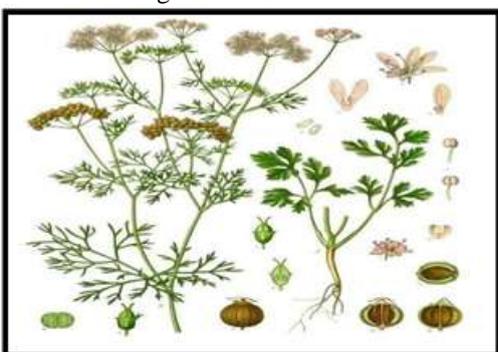


Figure no.-3 Fruit, roots, leaves.

In general, organic merchandise are sold at higher costs than standard merchandise as a result of consumers are willing to pay additional for merchandise that satisfies philosophical and health needs; however, they demand guarantees on the standard of organic merchandise. Thanks to the smallest use of agrochemicals, organic merchandise will provide the impression of lower quality, considering that quality.

Coriander (*C. sativum* L.) belonging to the family Umbelliferae/ carrot family could be a hairless aromatic, nonwoody annual plant, that contains a long history as a cooking herb being the supply of aroma compounds and Greek deity with biologically active elements possessing medicament, antifungal and inhibitor activities, and thus *C. sativum* is helpful in food preparation (as a ingredient agent and adjuvant) and preservation furthermore in preventing food borne diseases and food spoilage. *C. sativum* provides 2 varieties of seasoning raw materials- fruits and leaves, the most biologically active substance of that is EO. Coriander are seeds associated another to dishes as an aromatic spice, that at constant time act as organic

{process|biological process} agent fast the digestion process. The yield of *C. sativum* EO and its chemical composition undergoes changes throughout development that affects the aroma of the plant, and therefore the coriander fruit aroma is totally different from the aroma of the herb. Immature fruits associated leaves have an unpleasant odour known as a “stink bug smell” that is thanks to trans-tridecen contained within the oil. Coriander is observed as “kusthumbari” or “dhanayaka” within the Indic literature; in Hindi it's known as Dhania, whereas Dhane in Bengali. It's a native plant of the Jap Mediterranean from wherever it's going to have unfolded to Republic of India.

Coriander, according to the climatic conditions, is cultivated as a summer or winter annual crop. Coriander is tropical or subtropical crop and can tolerate heat and drought. For leaf purpose, coriander is grown all year round. It can fairly tolerate light frost and high temperature. The temperature of 15-25°C for vegetative growth and 20-30°C along with cool and dry weather for seed formation is considered good. Heavy rain affects the crop yield and quality badly. For very hot weather, the crop for leaves can be grown under assured irrigation facilities Bhandari. It shows broad adaptation by growing well under different types of soil and weather conditions. Among the primary nutrients, nitrogen has a considerable effect, not only on quality of produce but on quantity of produce also. Nitrogen is one of the major elements for growth and development of plant. It is involved in photosynthesis, respiration and protein synthesis. It imparts the dark green colour of the leaves, promotes vigorous vegetative growth and more efficient use of available inputs finally leads to higher productivity.

Coriandrum sativum has exerted pharmacological effects like antioxidant, antidiabetic, antimutagenic, anthelmintic, anticonvulsant, anxiolytic, and hepatoprotective. These effects are possibly regulated by the potent antioxidant activity of this plant and its main component, linalool. Herein, we have provided information on botanical aspects, ethnobotanical and ethnomedicinal effects, traditional and therapeutic values, and biochemical profile of *C. sativum*.

All parts of the plant are edible, but the fresh leaves and the dried seeds are the most common parts used in cooking. In the Indian traditional medicine, coriander is used in the disorders of digestive, respiratory and urinary

systems, as it has diaphoretic, diuretic, carminative and stimulant activity. In Iranian traditional medicine, Coriander has been indicated for a number of medical problems such as dyspeptic complaints, loss of appetite, convulsion and insomnia. The whole plant and especially the unripe fruit, is characterized by a strong disagreeable odour, whence the name coriander (from the Greek K'opis, a bug) giving characteristic aroma when rubbed.

II. MATERIALS AND METHODS

□ Experimental site

The present investigation was conducted in green house condition at Department of Biochemistry, College of Agriculture, Junagadh Agricultural University, Junagadh (Gujarat) during Rabi 201516. The experiment was conducted in the research field of Agronomy Farm of Institute of Agriculture and Animal Science (IAAS), Pakliha Campus, Rupandehi, Nepal during January to March, 2018. Geographically, the experimental site is located at an altitude of 79 m above sea level in Terai belt of Western Development Region of Nepal. The GPS coordinates of the site are 0742278 quite uniform in respect to its topography and total area occupied for the experimental purpose was 77 m².

□ Experimental soil

The soil was collected from Agronomy farm, Junagadh Agricultural University, Junagadh. These soil sterilized in autoclave dried properly and used for pot trial. There were 24 Pots, each with 40 cm deep and 45 cm wide, having capacity 40 kg soil/pot. Experimental soil was calcareous in texture and slightly alkaline in reaction having normal electrical conductivity.

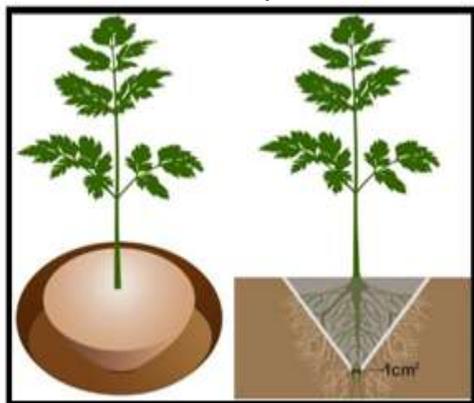


Figure no.-4 Growth in oil

□ PGPR culture (Plant growth promoting rhizobacteria)

Three plant growth promoting rhizobacteria (Azotobacter, PSB, and Pseudomonas) were obtained from Microbial Cell, Department of Biotechnology, Junagadh Agricultural University, Junagadh.

□ Seed materials

The coriander seeds (cv. Gujarat Coriander-2) were obtained from Department of seed science and technology, Junagadh Agricultural University, Junagadh, India



Fig No 05 : Coriander Seed

□ Seed treatment

Prior to treatments coriander seeds (Gujarat coriander-2) were sterilized with 70% ethanol and 0.1% mercuric chloride (Hg) and washed with distilled water for 4 times. Pure culture of PGPR (10⁸ CFU/ml) individually or in combination were treated with seeds. Seeds were not inoculated for control variant.

T1-Control

T2-Azotobacter

T3-PSB (Phosphate solubilizing bacteria)

T4-Pseudomonas

T5-Azotobacter+ PSB

T6-Azotobacter+Pseudomonas

T7-PSB+Pseudomonas

T8-Azotobacter+PSB+Pseudomonas

Pot trial. Pot trials square measure conducted in inexperienced house of organic chemistry Department, school of Agriculture, J.A.U., Junagadh. once [*fr1] Associate in Nursing hour of seed treatment, they were seeded in pots in 3 replications throughout Dec month. comfortable water is equipped to pots until the last stage. The seedlings were analyzed in four stages viz., S1 (5 DAG), S2 (10 DAG), S3 (15 DAG) and S4 (20

DAG).

Sample assortment.

The types of markets enclosed open, municipal, chain retailers and wholesale shops ensuring the association of low-middle-high financial gain family purchased RSV things. Total twelve markets were elect betting on the recognition inside national capital metropolitan town space. Among them, 3 markets [Agora (Gulshan-2), Swapno (Banani), and Minabazar (Dhanmondi)] were chosen as in style chain retailers. 3 markets (Kawran bazar, Shyambazar, and Jatrabari) were chosen as in style wholesale markets, and therefore the rests half-dozen were the favored retails market (New Market, Mohakhali, Khilkhet, Mirpur-1, Mohammadpur Krishi Market, and Santinagar bazaar.

Agro earth science observation.

The experimental web site has tropical climate with hot summer and funky winter. the realm has maximum temperature up to forty

five.2°C throughout hot months and minimum temperature up to two.4°C during cooler months with average rain of 1436.5mm (National Wheat analysis Program, 2018). Occasional showers of rains square measure received throughout winter months.

Physiochemical properties of soil

Random samples were collected from the experimental blocks before conducting the cultivation practices. Soil samples were sent to research laboratory to investigate the chemical composition of soil. Organic matter (3.35%), total chemical element (0.49%), accessible phosphorus (187.53 kg/ha), K₂O (123.11 kg/ha) and pH (5.2) of soils of experimental web site were assessed through research laboratory analysis.

Planting materials

The planting material (coriander varieties) was collected from totally different agro-vets of Butwal, Rupandehi, Nepal.

Table 1: List of coriander varieties used in the experiment

SN	Varieties	Sources
1	Khusboo	SakataSeedIndiaPvt. Ltd.,Haryana,India
2	Kalamy	GlobalSeedsPvt.Ltd.,Kathmandu,Nepal
3	Lotus	CHAI TAI,Thailand(Imported by: KarmaandSonsTradersinNepal)
4	Evergreen	NathBio-genes(I)Ltd.,Aurangabad,India
5	AmericanLongStanding	SEANSeedServiceCentreLtd.,Kathmandu,Nepal
6	Iko-BR-50	IkoHybridSeedsPvt.Ltd.,Delhi,India
7	Kasturi	RasiHyVeg(P)Ltd.,TamilNadu,India

8	Sugandh	RizwanSeedsCompany, Punjab, India
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III. EXPERIMENT AND DETAILS

The experiment was set up into straightforward randomised complete block style (RCBD) with eight treatments and 3 replications. All the treatments were supported the varietal variations (yielding behavior) of Chinese parsley. Coriander varieties were thought-about as treatment that includes Khusboo, Kalamy, Lotus, Evergreen, Americal Long Standing, IKO-BR-50, Kasturi and Sugandh. All the varieties square measure hybrid except yank Long Standing and Lotus. the dimensions of experimental unit is one.4 m² (1.4m × 1m) and therefore the gross size of the experimental space was seventy seven m² (15.4m × 5m). The spacing between blocks was 1m and between experimental units inside a block was zero.6m. the full range of plot was twenty four. there have been 5 rows per plot accommodating twenty eight plants per row. The row to row distance was twenty cm and plant to plant distance was 5 cm. There were altogether one hundred forty plants/ plot.

Growth of coriander. Data assortment

For observation, sample plants were elect from cyber web experimental plot excluding the border plants to avoid the border result. In every experimental unit, eighteen sample plants (10 sample plants for inexperienced leaf yield analysis, five sample plants for morphological characters and three sample plants for dry matter analysis) were elect every which way for recording knowledge on totally different growth and yield contributing characters. once choice, tagging was done to every sample plant and every one knowledge were noted on observation sheet.

Production method of Coriander Seeds.

Coriander crop needs a cool climate throughout the expansion stage and heat dry climate at maturity. It may be cultivated in most kinds of soils, however well-drained loamy soil suits the crop well. Cold



Figure no-6 Growth of coriander.

□ Data collection

For observation, sample plants were selected from the net experimental plot excluding the border plants to avoid the border effect. In each experimental unit, 18 sample plants (10 sample plants for green leaf yield analysis, 5 sample plants for morphological characters and 3 sample plants for dry matter analysis) were selected randomly for recording data on different growth and yield contributing characters. After selection, tagging was done to each sample plant and all data were noted on observation sheet.

□ Production Process of Coriander Seeds.

Coriander crop requires a cool climate during the growth stage and warm dry climate at maturity. It can be cultivated in most types of soils, but well-drained loamy soil suits the crop well. Cold climate and high altitudes may lead to superior quality seed and higher essential oil content. Crop duration of coriander is 110–140 days. Harvested plants are dried in the sunlight for 1-2 days to bring the moisture levels down to 18%. This dried plant is then thrashed to remove the seeds. Seeds are further dried in the shade to bring the moisture levels down to 9%. Coriander seed is mainly processed into powder by crushing, and this powder, with its aroma, is used as a food ingredient. The seeds are also used to extract essential oils.

Table2:Nutritional composition of seed powder.

Component	Corianderseed(%)
Drymatter	88.0
Crudeprotein	15.27
Crudefiber	33.64
Ether extract	20.0
Ash	9.50

Regional And Other Names Of Coriander

Gujarati (Dhana); Arab (kuzbara, kuzbura); Armenian (chamem); Chinese (yuan sui, hu sui);Czech (koriandr); Danish (coriander); Dutch (coriander); English (coriander, collender,chinese parsley); Ethiopian (dembilal French coriandre, persil arabe); Georgian (kinza, kindza, kindz); German (Koriander); Greek (koriannon, korion); Hindi (dhania, dhanya); Hungarian (coriander); Italian (coriandolo); Japanese (koendoro); Malay (ketumbar); Persian (geshnes); Polish (kolendra); Portugese (coentro); Rumanian (coriándru); Russian (koriandr, koljandra, kinec, kinza, vonjuezel'e, klopovnik); Sanskrit (dhanayaka.); kusthumbari (Serbokroatian korijander); Spanish (coriandro, cilantro, cilandrio, cilantro); Swiss (Chrapfechörnli, Bööberli, Rügelikümmi); Turkish (kisnis); English (Coriander fruits); Hindi (Dhaniya); Sanskrit (Dhanika, Dhania Vitunnaka); Kashmiri (Dhaniwal, Dhanawal); Oddiya (Dhania); Punjabi (Dhania); Bengali (Dhane, Dhania); Marathi(Dhaue,Kothimbir);Tamil (Kottamalli, Viral dhania); Telagu (Dhaniyalu); Urdu (Kishneez) .

IV. DRUG INFORMATION

Overview:-

Coriander in medicative amounts beside sedative medications would possibly cause an excessiveamount of temporary state. Some sedative medications embody clonazepam (Klonopin), Ativan (Ativan), barbiturate(Donnatal), zolpidem (Ambien), and lots of others.

Dosing

The appropriate dose of coriander depends on many factors like the user's age, health, {and several}and a number of different{and several other} other conditions. At this point there's not enough scientific info to work out AN acceptable vary of doses for as a preparation spice and to forestall illness.

In producing, coriander is employed as a flavouring agent in medicines and tobacco and as a fragrance in cosmetics and soaps.

How will it work?

Coriander could lower blood Coriander may be a plant. each the leaves and fruit (seeds) of coriander area unit used as food and medication. However, the term "coriander" is usually accustomed consult with the fruit. Coriander leaves area unit sometimessaid as cilantro. withinthe following sections, the term "coriander" are accustomed describe the fruit.

Coriander is employed for a long-run disorder of the big intestines that causes abdomen pain (irritable intestine syndrome or IBS), constipation, diarrhea, gas (flatulence), nausea, roundworm (Tinea pedis), and lots of different conditions, however there's no smart scientificproof to support these uses.

In foods, coriander is employed glucose and facilitate kill some parasites, however there presently is not enough info to grasp however coriander would possibly work for medicative uses.

Uses & Effectiveness Insufficient proof for Athlete's foot (Tinea pedis). Early analysis suggests that swing 6 June 1944 coriander oil on the skin helps to enhance symptoms of roundworm. A long-run disorder of the big intestine that causes abdomen pain (irritable intestine syndrome or IBS) Anxiety. Bacterial or fungous infections. Constipation. Convulsions. Diabetes. Diarrhea. Insomnia. Gas (flatulence). Joint pain and swelling. Nausea. Stomach upset. Worms. Other conditions. More proof is required to rate the effectiveness of coriander for these uses.

Facet Effects

When taken by mouth: Coriander is probably going safe once taken in food amounts. It's presumably safe for many individuals once taken in larger amounts as medication. Coriander will cause allergies. Symptoms of such reactions will embody respiratory disorder, nasal swelling, hives, or swelling within the mouth. These reactions seem to be commonest in folks that work with spices within the food trade

When applied to the skin: Coriander is presumably safe once used suitably. It will cause skin irritation and skin sensation. Special Precautions and Warnings physiological state and breast-feeding: there is not enough reliable info to grasp if coriander is safe to use once pregnant or breast-feeding. stay the safe facet and avoid use.

Allergies. folks that area unit allergic to wormwood, aniseed, caraway, fennel, dill, or similar plants may need allergies to coriander.

Diabetes. Coriander would possibly lower blood glucose levels. If you have got polygenic disease and take coriander, monitor your blood glucose levels closely

Low pressure level: Coriander would possibly decrease blood pressure. this might cause pressure level to travel to low in individuals with low pressure level. Use cautiously if you have got low pressure level or take medications to lower your pressure level.

Surgery: Coriander would possibly lower blood glucose. there's some concern that it would interfere with blood glucose management throughout surgery. Stop mistreatment coriander a minimum of a pair of weeks before a regular surgery.

Interactions Moderate Interaction

Be cautious with this mix

Medications for polygenic disease (Antidiabetes drugs) interacts with CORIANDER Coriander would possibly lower blood glucose. polygenic disease medications also are accustomed lower blood glucose. Taking coriander in medicative amounts beside polygenic disease medications would possibly cause your blood glucose to travel too low. Monitor your blood glucose closely. The dose of your polygenic disease medication would possibly got to be modified. Some medications used for polygenic disease embody glimepiride (Amaryl), DiaBeta (DiaBeta, Glynase PresTab, Micronase), insulin, pioglitazone (Actos), rosiglitazone (Avandia), chlorpropamide (Diabinese), glipizide (Glucotrol), Orinase (Orinase), and others. Medications for top pressure level (Antihypertensive drugs) interacts with CORIANDER Coriander would possibly decrease pressure level. Taking coriander in medicative amounts beside medications for top pressure level would possibly cause your pressure level to travel too low.

Some medications for top pressure level embody angiotensin converting enzyme inhibitor (Capoten), Vasotec (Vasotec), losartan (Cozaar), valsartan (Diovan), calcium-channel blocker (Cardizem), Amlodipine (Norvasc), HydroDIURIL (HydroDiuril), diuretic drug (Lasix), and lots of others.

Sedative medications (CNS depressants) interacts with CORIANDER

Coriander would possibly cause temporary state and sleepiness. Medications that cause temporary state area unit referred to as sedatives. mistreatment coriander. detain mind that natural product aren't forever essentially safe and dosages are often vital. make sure to follow relevant directions on product labels and consult your health {professional|health care provider|caregiver} or medical man or different care professional before mistreatment



Figure No. 7:- Disease in which coriander is use.

Monograph of herbal drugs as per WHO guidelines.

Monograph Title:-BOTANICAL.

Parameters:-Sensory Evaluation.

Types:-Visual Macroscopy; Touch; Taste; Odour; Size; Colour.

Parameters:-Foreingn Plants.

Types:-Foreing Animal,Foreing Mineral (Soil, Stones, S and, and Dust)

Microscopy:- Histological observation, Histochemical detection, Measurement of specimensetc.

Monograph Title:-PHYSICOCHEMICAL.

Parameter:-TLC.

Types:-Ascending technique, Horizontal technique,etc.

Parameter:-Ash.

Types:-Total, Acid insoluble, Water soluble.

Parameter:-Extractable Matter.

Types:- Hot water, Cold water and Ethanol.

Parameter:-Water content and volatile mater.

Types:-LOD, Azeotopic.

Parameter:-Volatileoils.

Types:-By Steam distillation.

Monograph Title:- PHARMACOLOGICAL.

Parameter:- Bitterness value.

Types:- Unit equation to the bitterness ofstandard solution of Quinine hydrochloride.

Paramter:- Haemolytic activity.

Types:- On oxygen blood by comparison with standard saponin.

Parameter:- Astrigency.

Types:- Fraction (tannins) that binds to standard

hide powder. Parameter:- Swelling index.

Types:- In water.

Parameter:- Foaming index.

Types:- Foam height produced by 1gm material under specified conditions.

Monograph Title:- TOXICOLOGICAL.

Parameter:- Pesticide residue

Types:- Total organic chloride and total organic phosphorus.

Parameter:- Arsenic.

Types:- Stain produced on HgBr₂ paper in comparison to standard stain.

Parameter:- Heavy metal.

Types:- Cadmium and Lead.

Monograph Title:- MICROBIAL CONTAMINATION.

Parameter:- Total viable aerobic count pathogens.

Types:- Enterobacteriaceae-E.coli Klebsiella, salmonella, staphylococcus aureus,Pseudomonas aeruginosa .

Parameter:- Aflatoxins

Types:-By TLC using standard aflatoxins (B1, B2 , G1,G2) mixture.

Monograph Title:-Radioactive Contamination.

Microbial growth in herbal can be avoided by irradiation. Nature and intensity of irradiationdepend on the source. The radio activity of the plant sample should be checked according tothe guiedlines of the International Atonic Energy Agency (IAEA) , Vienna ,Austeia.

Method of analysis of flavorer drug

1:- Organoleptic or morphological evalustion.

Coriander:- Coriander consists of dried ripe fruits of coriander plant Linn., happiness to familyUmbelliferae.

Synonyms:- Fructus coriandri, Coriander fruits, Cilantro, Chinese parsley.Colour :-Leave:- inexperienced to caramel brown of Indian Coriander

Seeds:- caramel brown to brown.

Odour:- Aromatic odour of rosid dicot family fruits.

Taste:- Spicy and characterstic. **Size:-** two to 4mm diameter. four to 8mm length.

Shape:- Cremocarp with ten primary ridges and eight secondary ridges.

Biological Source:- Coriander consists of dried ripe fruits of coriander plant Linn., happinessto family Umbelliferae

Geographical Sources:- Cultivated in Central and Japanese Europe, significantly in Russia, Hungary, in continent and Bharat. In Bharat it's cultivated in geographic area, U.P., Rajasthan, Jammu, and geographic area. It's additionally found in a very antiwild state within the east of Europeannation.

Cultivation and Collection:- The coriander seeds square measure seeded in dry weather either in March or in early season. Shallow drills, concerning 1/2 in. deep and eight inches apart square measure created and also the seed square measure seeded in it, the speed of germination is slow. The plants square measure annual herb, that grow to a height of one to three feet high, slender, and branched. The flowers square measure in shortly pedunculate umbels with 5 to 10 rays. The seeds fall as shortly as ripe and once the seeds square measure ripe (about August), the disagreeable odour is created. Plant is then impeded with sickles; the fruits square measure collected and dried. Throughout drying fruits develop aromatic smell and also the unpleasant odour disappears.

Characteristics

The fruit could be a cremocarp, subspherical in form, yellowish-brown in color. The dimensions of the fruit is three to four metric linear unit in diameter, with aromatic odour, and spicy, aromatic

Plant profile

Scientific classification

Scientific	Classification
Kingdom	Plantae
Subkingdom	Viridaeplantae
Infrakingdom	Streptophyta
Division	Tracheophyta
Subdivision	Spermatophytina
Infradivision	Angiospermae
Class	Magnoliopsida
Superorder	Asteranae
Order	Apiales

style.

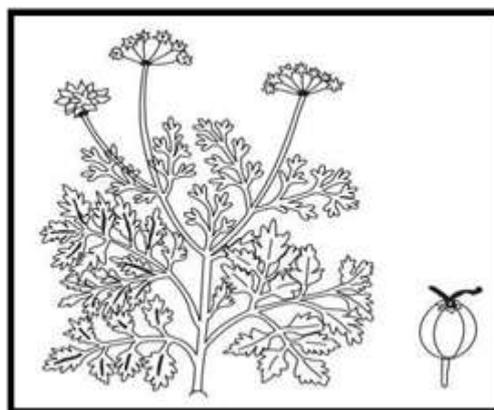


Figure no.8-Coriandrum sativum

Chemical Constituents

Coriander consists of about 1% of volatile oil. The chief volatile components are D-(+)-linalool (coriandrol), along with other constituents like, borneol, p-cymene, camphor, geraniol, limonene, and alpha-pinene. The fruits also contain fatty oil and hydroxycoumarins. The fatty oils include acids of petroselinic acid, oleic acid, linolenic acid, whereas the hydroxycoumarins include the umbelliferone and scopoletine.

Family	Apiaceae
Genu	Coriandrum L.–coriander

Plant components

Habit: Associate in Nursing annual cultivated herb.

Stem: Erect, herbaceous, inexperienced cylindrical, hollow, solid within the lower region, dichotomously

Inflorescence: A compound inflorescence. the first branches of a compound inflorescence area unit referred to as rays, the members of the involucre area unit bracts, and therefore the members of the involucre subtending the umbel are bractlets Umbellet Inflorescence

Flower: Six completely different forms of flower area unit present: Outermost Sterile Flower:

Pedicellate, bracteate, incomplete, zygomorphous. Outer feminine Flower: Pedicellate, bracteate, unisexual, zygomorphous, epigynous.

Outer Male Flower: Pedicellate, bracteate, unisexual, zygomorphous. herb L.) amplexicaul,

•Outer Bisexual Flower: Pedicellate, bracteate, bisexual, zygomorphous, epigynous.

Inner Male Flower: sexual, actinoid. Inner Bisexual Flower: Bisexual, complete, actinoid,

epigynous. Calyx: five sepals, gamosepalous, in zygomorphous flowers 2 anterior sepals area unit larger, valvate, green, persistent, epigynous, all sepals equal-sized in actinoid flowers. Corolla: five petals, petalous, chromatic white, valvate lobate, the zygomorphous flowers have Associate in Nursing anterior massive 2 on its sides area unit with one massive and one tiny lobe and therefore the rest 2 have two tiny lobes each; all petals area unit of equal size in actinoid (central) flowers.

Androecium: five stamens, curving in bud condition, free, epigynous; filaments long, reproductive structure dorsifixed and extrose

Gynoecium: Bicarpellary, syncarpous, ovary inferior, bilocular, placentation, one ovule in every locule, 2 fla stigmas, 2 long designs that flatten at the bottom into a bilobed epigynous disc referred to as style.

Fruit: A cremocarp that splits up into 2 mericarps that stay suspended on the carpophores for a few time.

Microscopical Evaluation

Microscopy

The transverse section of coriander shows the presence of a dorsal surface and a

commissural surface. The dorsal surface consists of two vittae and a carpophore. The dorsal surface has five primary ridges and four secondary ridges. The epicarp consists of a single row of small thick-walled cells with calcium oxalate crystals. The mesocarp has an outer loosely arranged tangentially elongated parenchyma cells and the middle layer consisting of sclerenchyma. The middle layer is again divided into; the outer region of sclerenchyma is represented by longitudinally running fibres, whereas the inner region has tangentially running fibres. The vascular bundles are present below the primary ridges. The inner layer has polygonal, irregularly arranged parenchyma cells. The endocarp has the parquetry arrangement. In the testa it has single-layered, yellowish cells, and the endosperm is thick, polygonal, colourless parenchyma with fixed oil and aleurone grains.

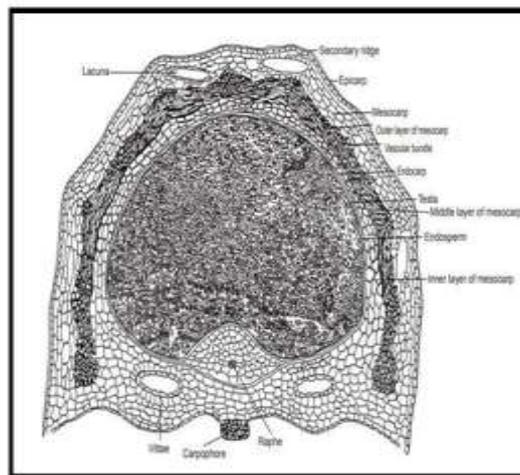


Figure no.9-Transverse section of coriander fruit (mericarp).

Method of evaluation of herbal drug

Method of evaluation of herbal drug

Biological Evaluation

Antioxidant effect

Antimicrobial and anthelmintic Effects

Anticancer effect

Anxiolytic effect

Antimigraine effect

Antiseizure effect

Antimigraine effect

Neuroprotective effect
 Analgesic effect
 Anti mutagenic activity
 Diuretic Anthelmentic activity.
 Skin disease.
 Analytical Evaluation

Gas chromatography(GC)

GC analysis was performed using a Shimadzu GC-9A gas chromatograph equipped with a DB-5 fused silica column (30 m × 0.25 mm i.d., film thickness 0.25 µm). The oven temperature was held at 40 °C for 5 min and then programmed until 250 °C at a rate of 4 °C/min. Injector and detector (FID) temperature were 260 °C; helium was used as a carrier gas with a linear velocity of 32 cm/s.

Gas chromatography–massspectrometry

GC–MS analyses were carried out on a Varian 3400 system equipped with a DB-5 fused silicacolumn (30 m × 0.25 mm i.d.); oven temperature was 40 to 240 °C at a rate of 4 °C/min, transfer line temperature 260 °C, injector temperature 250 °C, carrier gas helium with a linear velocity of 31.5 cm/s, split ratio 1/60, flow rate 1.1 ml/min, ionization energy 70 eV; scan time 1 s; mass range 40–350 amu.

Qualitative and quantitative analysis of essentialoil

Identifications were made by library searches (Adams 1995), combining MS and retention data of authentic compounds by comparison of their GC retention indices (RI) with those of the literature or with those of standards

available in our laboratories. The retention indices were determined in relation to a homologous series of n-alkanes (C8–C22) under the same operating conditions. Further identification was made by comparison of their mass spectra with those stored in NIST 98 and Wiley5 Libraries or with mass spectra from the literature. Component relative concentrations were calculated based on GC peak areas without using correction factors.

Physical Evaluation

Moisture content:-
 Moisture content of coriander is 8.9 – 0.2.
 Melting point:-
 Melting point of coriander is 193 o C (lit)
 Solubility :-
 Soluble in water.
 Opticalrotation:-
 Coriander oil 7.0 – 13.0
 Refractive index : 20oC. 1.4620 – 1.4700

6. Ash value :- 2.0 – 0.9.
 Acid in soluble ash value :- 0.2 – 0.1.
 Water soluble ash value:- 1.0 – 0.5. 7.
 Volatile oil content:- 0.2 % - 1.5 %

List of various marketed preparation.

Nowdays, Coriander is available as the marketed formulation for curing numerous clinical conditions and is accessible in combination with varios other ingredient some of which are enlisted in following table:

Sr.No	NameoftheFormulation	Ingredient	Use
1	 <p>CorianderCapsules</p>	<p>Coriander Seed Powder(Coriandrum sativum) -470mg percapsule</p> <p>OtherIngredients:VegetableHPMCCapsule(HydroxypropylMethylcellulose)</p>	<p>Take2to4capsulesdailywith warm wateror as directed byyourhealthpractitioner.Donot exceed stateddose.</p>

2	KidneyFormula™tablets 	Gokshurafruit,Punarnavaroot,Guduchiherb,Manjistharoot,Musta Anantamulindicus), Passionflowerherb,AmalakifruitBibhitakifruit HaritakifruitCorianderseed Fennelseed	Used to support the healthy kidneys and adrenals.
3	Aroma Therapy coriander leaf 	Leaves of coriander	Analgesic, antispasmodic, carminative, depurative, deodorant, digestive, carminative, fungicidal, lipolytic, stimulant and stomachic
4	Cilantro (Coriander) Leaf Cream 	Cilantro (Coriander) Leaf Cream	<u>Beauty</u> <u>.SkinCare.Face.Creams</u> <u>&Moisturisers</u> <u>.Face Cream</u>
5	Crabtree & Evelyn Energising Hand Cream Therapy, Citron and Coriander 	WATER (AQUA)(EAU). MACADAMIA TERNIFOLIA SEED OIL. ZEA MAYS	This intensive cream nourishes skin so it's noticeably smoother after each application

V. RESULT AND CONCLUSION

The major constituent of the essential oil from dry seeds of *C. sativum* was linalool (59.6%), while the major constituents of dry waste essential oil were trans-anethole (29.29) and then linalool (20.06%). The constituents of coriander oil are greatly affected by the method of storage.

It was observed that the largest change in essential oils was found in dry seeds and dry waste after 1 year of storage. Storage of coriander oil immediately after extraction in the refrigerator is less harmful than extracting from seeds or waste stored for 1 year at room temperature.

However, this does not prevent the use of coriander oil from seeds or waste stored at room temperature if needed, but with a lower quality than those extracted immediately after harvest or if stored directly in cool conditions. Also, the waste of *C. sativum* can be used as a fertilizer or as a new source of essential oil, as well as protecting the environment from pollution resulting from the presence of coriander wastes.

The present study revealed that the powder solution gives different color in different solvent. The percentage of inorganic material in the form of total ash is 8.5%. While acid insoluble ash is 41% and water soluble 16%. While tapped density and bulk density are the density of the powder itself and Carr's index is the parameter which shows the flowability of the powder

Coriandrum sativum L. is having good flowability because its Carr's index is <25%. The powder of plant leaves was extracted by three different solvents, that is, alcohol, ether, and aqueous extract. For aqueous extract, microwave is used as energy supplier. The percentage of MAE is high as compare with other solvent extraction. Qualitative phytochemical test shows the presence of alkaloids, carbohydrate, and phenolic compounds which were further confirm by infrared spectroscopy. The extract is also active against *Escherichia coli*, *Bacillus subtilis*, and *Staphylococcus aureus* but inactive against *S.typhi*

VI. LITERATURE OF REVIEW

1-International Journal of Current Microbiology and applied science. Growth yield attributes and yield of coriander (*Coriandrum sativum* L.) as influence by weed management practices and nitrogen level. ISSN 2319-7706 volume 9, November 4, (2020). J.K. Patil, A.U. Amin, Y.A. Tamboli & U.V. Patel:- An experiment was conducted at Agronomy Instructional Farm, C. P. College of Agriculture, S. D. Agricultural

University, Sardarkrushinagar during rabi season of 2016-17 to study the effect of weed and nitrogen management in coriander (*Coriandrum sativum* L.). The experiment evaluated in Randomized block design with factorial concept and replicated three times. Results show that the significantly lower weed count at 40 (0.71m⁻²) and 60 (0.71m⁻²) DAS, dry weight of weeds (0.00 kg ha⁻¹) and weed index (0%). Whereas, the significantly higher weed control efficiency (100%), superior growth parameters, yield attributes and higher seed (1055 kg ha⁻¹) and straw (1688 kg ha⁻¹) yield were recorded under weed free (W2) and was at par with pre emergence application of pendimethalin 1 kg ha⁻¹ + interculturing followed by HW at 30 days after sowing (W6). The application of 60 kg N ha⁻¹ (N3) recorded significantly higher values of growth parameters, yield attributes and maximum seed (849 kg ha⁻¹) and straw (1373 kg ha⁻¹) yield and was at par with 40 kg N ha⁻¹ (N2). Weed count and dry weight of weeds increased significantly with each increase in nitrogen levels from 20 to 60 kg N/ha. But number of weeds per m² was not influenced by different nitrogen levels. Whereas, the plant population and harvest index was not remarkably influenced by both weed management practices and nitrogen levels. This study revealed that, efficient weed management and remunerative higher yield of coriander can be obtained by adopting integrated weed management approach i.e., application of pendimethalin 1 kg ha⁻¹ as pre emergence + interculturing followed by hand weeding at 30 DAS along with application of 40 kg N ha⁻¹ under North Gujarat Agro-climatic condition.

Asian Pacific Journal of Tropical Biomedicine journal. Coriander (*Coriandrum sativum* L.) essential oil: Chemistry and biological activity Shyamapada Mandal, Manisha Mandal:- *Coriandrum sativum* L. (*C. sativum*) is one of the most useful essential oil bearing spices as well as medicinal plants, belonging to the family Umbelliferae/Apiaceae. The leaves and seeds of the plant are widely used in folk medicine in addition to its use as a seasoning in food preparation. The *C. sativum* essential oil and extracts possess promising antibacterial, antifungal and anti-oxidative activities as various chemical components in different parts of the plant, which thus play a great role in maintaining the shelf-life of foods by preventing their spoilage. This edible plant is non-toxic to humans, and the *C. sativum* essential oil is thus used in different ways, viz., in foods (like flavouring and preservatives) and in

pharmaceutical products (therapeutic action) as well as in perfumes (fragancias and lotions). The current updates on the usefulness of the plant *C. sativum* are due to scientific research published in different web-based journals.

Different Responses of the Quality Parameters of *Coriandrum sativum* to Organic Substrate Mixtures and Fertilization Neith A. Pacheco L. , Julia Cano-Sosa , Fernando Poblano C. , Ingrid M. Rodríguez-Buenfil and Ana Ramos-Díaz:- In order to standardize the quality of agricultural products, it is necessary to control the factors affecting plant development, such as plant nutrition. The best results in terms of homogeneity of the quality of vegetable crops were achieved using inert substrates and application of nutrients; however, production costs are high due to the cost of irrigation systems and substrate management and importation. This work aims to evaluate the effect of the local substrate mix and the amount of organic fertilizer on different quality parameters of coriander. To evaluate the quality of coriander, we considered different parameters such as size, biomass, antioxidant capacity and aroma (evaluated by volatile compounds detection with gas chromatography). The results show that the culture system differentially affects each parameter, and the compounds associated with the aroma of coriander and the diameter of plants are sensitive to the culture system, while the length of plants, number of leaves and antioxidant activity are not affected by the concentration of fertilizer. Moreover, organic farming conditions do not reduce quality parameters of the crops when using adequate fertilization. Additionally, local substrates would be practical substitutes for expensive importations.

Evaluation of coriander (*Coriandrum sativum* L.) varieties for growth and yield parameters Duwall, A. Nepal, S. Luitell, S. Acharya, R. Pathak, P. R. Poudel and J. Shrestha² Nepalese Journal of Agricultural Sciences, 2019, vol. 18 . Coriander (*Coriandrum sativum* L.) is one of the important spice crops. Its leaves and seeds are widely used as a condiment and spice in Nepal. Eight varieties of coriander were evaluated at research field of Institute of Agriculture and Animal Science (IAAS), Paklihawa Campus, Rupandehi, Nepal during January to March 2018. Eight varieties namely Khusboo, Kalamy, Lotus, Evergreen, American Long Standing, IKO-BR-50, Kasturi and Sugandh were evaluated in a Randomized Complete Block Design (RCBD) in three replications to compare them for

various growth and yield parameters. The results revealed that variety namely IKO-BR-50 gave the highest green leaf yield of 15 t/ha followed by Sugandh (14 t/ha), and Kasturi (14 t/ha), respectively. The highest bolting percent was found in Khusboo (100%) and the lowest in Kalamy (73%) at 85 days after sowing. The number of leaves was the highest in Kasturi (27) followed by IKO-BR-50 (24) and Kalamy (23), respectively. The highest benefit cost ratio (3.00) was given by IKO-BR-50 followed by Sugandh (2.76) and Kasturi (2.74), respectively. Amongst the eight coriander varieties, IKO-BR-50, Kasturi and Sugandh performed better in almost all the characters and gave higher net returns. This study suggests that the farmers should grow these varieties for higher production and higher economic return.

Ethnobotanical and phytochemical aspects of the edible herb *Coriandrum sativum* L. Zahra Sobhani Leila Mohtashami Mohammad Sadegh Amiri Mahin Ramezani Seyed Ahmad Emami Jesus Simal-Gandara 23 Jan 2022. *Coriandrum sativum* (coriander) is an edible herb in the family Apiaceae. The leaves, fruits, and stems of *C. sativum* have long been used as culinary spice due to their favorable odor. Traditional practitioners used this plant for treating different diseases like blepharitis, scabies, aphthous stomatitis, laryngitis, headache, and palpitation. In modern researches, coriander has demonstrated anxiolytic, anticonvulsant, antimigraine, neuroprotective, analgesic, diuretic, hypoglycemic, hypolipidemic, hypotensive, anticancer, and antioxidant activities. Coriander contains a wide range of bioactive phytochemicals among which phenylpropenes, terpenoids, isocoumarins, phytosterols, and fatty acids are the most important. This review provides information about the botanical and ethnobotanical aspects, chemical profile, therapeutic uses in Islamic traditional medicine (ITM), and recent pharmacological studies of coriander effects. The results have shown that coriander and its monoterpene compound, linalool, can be considered as potential drug candidates for treating metabolic syndrome and different inflammatory conditions especially neural and CNS diseases.

REFERENCE

- [1]. International Journal of Current Microbiology and applied science. Growth yield attributes and yield of coriander (*Coriandrum sativum* L.) as influenced by

- weed management practice and nitrogen level. ISSN 2319-7706 volume 9, november 4, (2020). J.K. Patil, A.U. Amin, Y.A. Tamboli & U.V. Patel.
- [2]. Asian Pacific Journal of Tropical Biomedicine journal. Coriander (*Coriandrum sativum* L.) essential oil: Chemistry and biological activity Shyamapada Mandal, Manisha Mandal.
- [3]. Different Responses of the Quality Parameters of *Coriandrum sativum* to Organic Substrate Mixtures and Fertilization Neith A. Pacheco L. , Julia Cano-Sosa , Fernando Poblano C. , Ingrid M. Rodríguez-Buenfil and Ana Ramos-Díaz .
- [4]. Evaluation of coriander (*Coriandrum sativum* L.) varieties for growth and yield parameters Duwall, A. Nepal1, S. Luitell, S. Acharya1, R. Pathak1, P. R. Poudell and J. Shrestha2 Nepalese Journal of Agricultural Sciences, 2019, vol. 18
- [5]. Ethnobotanical and phytochemical aspects of the edible herb *Coriandrum sativum* L. Zahra Sobhani Leila Mohtashami Mohammad Sadegh Amiri Mahin Ramezani Seyed Ahmad Emami Jesus Simal-Gandara 23 jan 2022.
- [6]. A study on the prevalence of heavy metals, pesticides, and microbial contaminants and antibiotics resistance pathogens in raw salad vegetables sold in Dhaka, Bangladesh article 30 jan 2019. Sunzid Ahmed , Md. Abubakkar Siddique , Matiur Rahman , Md. Latiful Bari , Shahnila Ferdousi . 37
- [7]. ASIAN JOURNAL OF PHARMACEUTICAL AND CLINICAL RESEARCH Phytochemical and physicochemical analysis of microwave-assisted extraction *coriandrum sativum* l. Leaves and its biological evaluation . Samreen fatema1, mazahar farooqui2, pathan mohd arif1, syed ummul khair asemal.
- [8]. International Journal of Current Microbiology and Applied Sciences Volume 6 Number 3 (2017) pp. 1935-1944. The Effect of Plant Growth Promoting Rhizobacteria (PGPR) on Biochemical Parameters of Coriander (*Coriandrum sativum* L.) Seedling S.I. Warwate, U.K. Kandoliya, N.V. Bhadja and B.A. Golakiya
- [9]. JOURNAL OF APPLIED PHARMACEUTICAL SCIENCE Phytopharmacological Properties of Coriander *Sativum* as a Potential Medicinal Tree: An Overview Pathak Nimish L, Kasture Sanjay B, Bhatt Nayna M and Rathod Jaimik D
- [10]. Effects of Different Levels of Coriander (*Coriandrum sativum*) Seed Powder and Extract on Serum Biochemical Parameters, Microbiota, and Immunity in Broiler Chicks Hesam Hosseinzadeh, Ali Ahmad Alaw Qotbi, Alireza Seidavi, David Norris, and David Brown.
- [11]. Aishwath, O.P., Lal, G., Kant, K., Sharma, Y.K., Ali, S.F. and Naimuddin, 2012. Influence of biofertilizers on growth and yield of coriander under typical haplustepts. Inter. J. Seed Spic.
- [12]. Alireza, P. 2015. Evaluation of flavonoids and phenols content of wheat under different lead, PGPR and Mycorrhiza levels. Bio.
- [13]. Association of Official Analytical Chemists (AOAC) (2005). Official methods of analysis of AOAC International. 18th edition. Maryland, USA: AOAC International.
- [14]. Barriuso, J., Solano, B.R., Lucas, J.A., Probanza, A.L., García-Villaraco, A. and Gutiérrez Mañero, F.J. 2008. Plant-Bacteria Interactions. Strategies and Techniques to Promote Plant Growth, J.P.S.H. Iqbal Ahmad, Willey-VCH Verlag GmbH & Co. KGaA, Weinheim.
- [15]. Bray, H.G. and Thorpe, W.V. 1954. Analysis of phenolic compounds of interest in metabolism. Metho. Biochem. Anal.
- [16]. De Freitas, J.R., Banerjee, M.R. and Germida, J.J. 1997. Phosphate-solubilizing rhizobacteria enhance the growth and yield but not phosphorus uptake of canola (*Brassica napus* L.). Biol. 38 Fertil. Soils. 16. Ezawa, T., Smith, S.E. and Smith, F.A. 2002. P Metabolism and Transport in AM Fungi. Plant and soil.
- [17]. Garcia, J.L., Probanza, A., Ramos, B. and Manero, F.J.G. 2001. Ecology, genetic diversity and screening strategies of plant growth promoting rhizobacteria. J. Plant Nutri. Soil Sci.
- [18]. Girenko, M.M. 1982. Initial material and basic trends in breeding of some

- uncommon species of vegetables [in Russ., Eng. abstr.]. Bull. VIR im. Vavilova..
- [19]. Guenther, E. 1952. The production of essential oils: Methods of distillation, enfiorage, maceration and extraction with volatile solvents In: Guenther, E (Eds),. The essential oils. Historyorigin in plants, production analysis Kreieger publ. co. Malabar, Fiorida, USA
- [20]. Hafsa, N. and Asghari, B. 2014. Role of plant growth promoting rhizobacteria and their exopolysaccharide in drought tolerance of maize. J. Pl. Inter
- [21]. Hedge, J.E. and Hofreiter, B.T. 1962. In: Methods in Carbohydrates Chemistry, (Eds.) Whistler, R.L. and BeMiller, J.N., Academic Press, New York.
- [22]. Kandoliya, U.K. and Vakharia, D.N. 2013. Antagonistic effect of *Pseudomonas fluorescens* against *fusariumoxysporum* f.sp. Ciceri causing wilt in chickpea. Legume Res.
- [23]. Khalid, A., Arshad, M., Zahir, Z.A. 2004. Screening plant growth promoting rhizobacteria for improving growth and yield of wheat. J. Appl. Microbiol.
- [24]. Khan, M.A. and Almas, Z. 2002. Plant growth promoting rhizobacteria from rhizospheres of wheat and chick pea. Ann. Pl. Protec. Sci.
- [25]. Kloepper, J.W., Schroth, M.N. and Miller, T.D. 1980. Effects of rhizosphere colonization by plant growthpromoting rhizobacteria on potato plant development and yield. Phytopatholog.,
- [26]. Lee, Y.P. and Takahashi, T. 1966. An improved colorimetric determination of amino acids with the use of ninhydrin. Analy. Biochem