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"Bioactive Constituents And Health Benefits Of Bitter Gourd (Momordica Charantia)"

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Abstract:

Cold press extraction is mechanical extraction techniques which is simple, conventional and eco-friendly method, requires less energy and temperature. The processes like cleaning, washing, crushing and collection of oil or juice from plant is carried out by cold press method. The oil obtained from cold press method can be suitable for direct consumption. Bitter gourd(Momordica charantia) also known as bitter melon or karela. Various varieties of bitter gourd present such as Arka Harita,Priya(VK-1), Pant Karela -1(PBIG-1), Phule Priyanka(RHRBGH -1), NBGH-167(hybrid),Vivek(hybrid),Pusa Aushadhi(Sel-I). It has high nutritional profile and contain various phytoconstituents like saponin, phenolic content and triterpenoids like charatin, vitamins, proteins, fatty acids such as alpha eleosteric acid which act as key nutrient in treatment of various diseases. Owing presence of various phytoconstituents it has Anti-cancer, Anti diabetic, Antioxidant, Wound healing, Antiinflammatory, Anti-hyperlipidemic activity. Bitter gourd- tablets, capsules, syrup, powder, cream, juice, tea present in market which plays important role in treatment of various diseases.

KEY WORDS: Bitter gourd, Extraction, Cold press method.

INTRODUCTION:

In the health field, plants and the products they produce are essential for both the provision of essential nutrients and the prevention of a number of diseases. They do in fact raise people's standard of living everywhere in the world Since ancient times, plant-based traditional medicines have also been used but standardizing them is necessary to evaluate their potential. Such plant and their bioactive components offers protection against vaarious diseases in human being .

Bitter Gourd:

There are several names for the vegetable Momordica charantia L., Cucurbitaceae, including bitter melon, bitter cucumber, balsam pear, and African cucumber . In addition to being used extensively in traditional medicine and planted as a decorative, it has a wide range of culinary applications, particularly in south, southeast, and east Asia.fruits are typically blanched, parboiled, or soaked in salt water before cooking in order to lesser their bitter flavour.

Momordicacharantia, the scientific name for bitter gourd, is a tropical vine that is primarily grown in Southeast Asia, China, and India. It is acknowledged for its high nutritional profile and medicinal qualities despite having an unpleasant, bitter taste. The fruit contains more than 60 phytomedicines that are useful in treating a range of illnesses, such as diabetes and cancer.Momordica charantia, the scientific name for bitter gourd, is a tropical vine that is primarily grown in Southeast Asia, China, and India. It is known for its high nutritional profile and medicinal qualities, despite its disagreeable harsh taste. The fruit contains more than 60 phytomedicines that are useful in treating a range of illnesses, such as diabetes and cancer.[1] [2] Additionally, recent developments in culture methods have increased its output and seedling growth efficiency.[3]The tropical vine known as the bitter gourd, or bitter melon, is prized for its nutrient-dense, edible fruit that also has therapeutic benefits, particularly in the treatment of diabetes. [4]

Table no.1: Various varieties of bitter gourd.[14]

Name of varieties /hybrid	**Source**	**Special feature**
Arka Harit	ICAR-IIHR,Bngaluru	It is a selection of pure lines from the Rajasthani native collection (IIHR-4). The slim vine has strongly lobed, light-green leaves. The fruits have a beautiful spindle shape, a glossy green color, smooth, regular ribs, and thick, tubercle-free meat and skin. The yield is 12.5–13.5 t/ha on average. Crops last between 100 and 110 days.
-1) Priya (VK	KAU Vellanikara (kerala)	It is a collection of locally available content. bears long, spiky, green fruits with a white tinge at the tip. The fruits are (40 cm) and 17 cm in girth with flesh thickness of 5-9 mm, average fruit weight 225 g; and each fruit bears 24 seeds weighing 6 g (100 seeds weight is 24 g). The yield is 30.0-32.5 t/ha on average. It can be grown from January to August and from September to December. The states of West Bengal, Assam, Madhya Pradesh, Maharashtra, Karnataka, Tamil Nadu, and Kerala have all been advised to cultivate it.
Pant (PBIG-1) Karela-1	GBPAT and Tech.Pantnagar (Uttarakhand)	Pure line selection from native germplasm inbreds is what this is. In 1999, the Uttar Pradesh State Variety

		Release Committee released it, and in 2001, the All India Coordinated Project (Vegetable Crops) identified it. Fruits are 15.0 cm long with tapering ends, and plants are 2.0 m long. The potential yield is 15.0 t/ha, and the first picking takes 55 days. It can be grown in hilly terrain.
Phule Priyanka (RHRBGH-1)	MPKV.Rahuri (Maharashtra)	RHRBG-5 and RHRBG-4 were crossed to create this hybrid. The fruits are 20 cm long, dark green, and have a strongly prickly skin. This hybrid may be grown in both the summer and rainy seasons. It can withstand downy mildew. After 180 days of cropping, it yields an average of 28.27 t/ha. Maharashtra has being advised to cultivate it.
Pusa Hybrid-2	ICAR-IARI,New Delhi	Using inbred Pusa Vishesh and Pusa Do Mausami, heterosis breeding was used to create this hybrid. The medium-sized, long, glossy green fruits are good for picking and drying. The first pickling begins 55–60 days after the seeds are sown. It can be grown in Punjab, Uttar Pradesh, Bihar, and Jharkhand throughout the spring and summer months. It has a production potential of 20.00 t/ha and is found in Chhattisgarh, Odisha, Andhra Pradesh, Rajasthan, Gujarat, Haryana, and Delhi. Compared to Pusa Vishesh and Pusa Do Mausami, it yields 42% and 48% more, respectively.
NBGH-167(Hybrid)	Nirmal Seeds Co	After planting, choosing takes place 55–60 days later. Medium-long, spindleshaped, dark, glossy green fruits with sharp, prickly edges. uniform fruit size, appealing
		appearance, and superior preservation quality. tolerant of downy and powdery mildew.
Vivek (Hybrid)	Sungro Seeds Co	After 55 to 60 days of seeding, the fruits are ready to be harvested. The fruits are 22 cm long and 16 cm wide. Fruits weigh between 80 and 85 grams on average.

Pusa Aushadhi	ICAR-IARI,New Delhi	Its fruits are medium in length (16.5 cm), medium in thickness, and light green in color. Fruits develop in 48–52 days and feature 7-8 continuous narrow ridges. The average output was 12.80 t/ha, and the average fruit weight was 85 g.

The cultivated and wild varieties of the bitter gourd (Momordica charantia) differ in a number of unique morphological characteristics. Several morphological characteristics are essential for identifying and classifying this plant, which is a member of the Cucurbitaceae family.

Table 2: Taxonomical classification of Bitter gourd[13]

Common name	Karela ,Bitter gourd
Kingdom	Plantae
Order	Cucurbitales
Species	M. charantia
Genus	Momordica
Family	Cucurbitaceous
Class	Magnoliopsida
Division	Magnoliophyta

Plant structure- The bitter gourd is an annual climber that is monoecious and has long-stalked leaves.

Leaves: The plant's overall appearance is influenced by the lobed and shaped leaves. Flowers: In the leaf axils, it bears solitary, yellow male and female flowers. [5]

Fruit characteristics- Fruit shape: The warty, oblong or elliptical "pepo" fruit can vary greatly in shape, particularly between the wild (var. muricata) and cultivated (var. charantia) varieties, which can range from discoid to spindle-rhomboid.

Seed morphology: Another effective indicator for differentiating between wild and domesticated kinds is the seeds' variability.[6]

Chromosomal features- Karyotype: The symmetrical karyotype of bitter gourds, which have 22 tiny chromosomes, suggests a complicated genetic structure that affects their physical characteristics.[7]

Nutritional Benefits- Abundant in vitamins, including beta-carotene, riboflavin, and thiamine. includes the vital elements potassium, iron, and calcium. rich in dietary fibre, which supports healthy digestion.[2]

Pharmcological Importance of Bitter gourd: The bitter gourd, or Momordica charantia, is well known for a variety of pharmacological substances that support its therapeutic qualities. Alkaloids, flavonoids, and triterpenoids are among the more than 60 phytonutrients found in the fruit that have been connected to a number of health advantages. These substances are essential for the treatment of conditions like diabetes, cancer, and inflammation

Key bioactive components-

Alkaloids and Triterpenoids: Notable substances with antidiabetic and anticancer effects include cucurbitacin B and momordicin I and II.[8] [9]

Phenolic compounds: Known for their antioxidant properties, these include caffeic acid and gallic acid, which aid in the fight against oxidative stress.[10]

Saponins: These substances, which belong to two groups (Oleanane and Cucurbitane), support bitter gourd's anti-inflammatory and hypolipidemic properties.[9] [11]

Health benefits-

Antidiabetic effect: Phenolics, carotenoids, curcubitane triterpenoids, alkaloids, and saponins are some of the main pharmacological components of bitter gourd that support its anti-diabetic qualities.[12]

Anticancer property: A number of bioactive substances help to stop the formation of tumours.[11]

Cardiovascular protection: Momordicin I, II, and cucurbitacin B are important pharmacological components of bitter gourd that support its therapeutic qualities and health advantages. It prevents atherosclerosis and aids in cholesterol regulation.[8]

Although bitter gourd is praised for its health advantages, its bitter flavour frequently prevents it from being included in diets. Innovative processing techniques, however, can improve its nutritional value and palatability, increasing its accessibility for intake.

Chemical constituent of bitter gourd:

Numerous chemical components found in bitter gourd (Momordica charantia) give it its therapeutic qualities. The fruit, seeds, and stem are the main plant components that contain these bioactive substances. The main ingredients in these sections are described in detail in the sections that follow.

Bitter gourd is source of several key nutrients. Vitamins A, E, thiamine, riboflavin, niacin, folate, and C are all abundant in the fruit. It also contains high levels of calcium, magnesium phosphorus, zinc, potassium, and iron. It has a healthy dose of dietary fibre[1] . Leaf, fruit, and seed had respective calorific values of 213.26, 241.66, and 176.61 kcal/100 g. In terms of nutritional makeup, Momordica charantia is composed of 1.4% fibre, 4.2% carbs, 0.20% fat, and 91.8% water .The proteins that are separated into albumin, globulin, and glutelin have respective concentrations of 49.3, 29.3, and 3.1%.[13] Vitamin c :Vitamin c is most abundently present in bitter gourd plant . Leaf: contain 205mg /100 gm D Fruit:contain 2022 mg/100 gm DW and more amount present in younger fruits[1]. young immature bitter gourds are ideal for cooking, It is abundant in iron and phosphorus. Minerals including calcium, phosphorus, iron, copper, and potassium are also present. Young leaves and shoots are a good source of vitamin A and a moderate supply of calcium, phosphorus, protein, and thiamin. It has twice as much calcium as spinach and twice as much beta-carotene as broccoli.[14] The seeds of bitter melon comprise approximately 35% to 40% oil, with the fatty acid profile revealing 3.33% monounsaturated fatty acids (MUFA) and 36.71% saturated fatty acids (SFA). The largest amount (59.96%) of PUFA (polyunsaturated fatty acids) are found to be present in bitter melon. Amongst PUFA, α-eleostearic acid (54.26%) is a conjugated linolenic acid and is of significance importance.Bitter melon seeds have a slightly different mineral profile since they are more plentiful in fruit and leaves and contain the highest concentrations of potassium, magnesium, calcium, sodium, and phosphorus. However, with naturally occurring concentrations of 5.65 and 45.45 mg/100 g of chromium and zinc, respectively, seeds are among the greatest natural suppliers of these element.[13]

Table no.3: chemical constituent of bitter gourd.

Plant parts	Chemical Constituents	Properties	Reference
Fruit	Flavanoids, Phenolics.	Antioxidant and help in diabetes.	[17] [18]
	Triterpenoids-cucurbitane-type triterpenoids, including sapogenins and saponins.	Responsible for the bitter taste and possess significant medicinal value.	[19]
	Amino acids –aspartic acid,serine, glutamic acid,threonine,alanine,g-amino butyric acid,pipecolic acid,lutolin		[16]
	Fatty acids- Louric,myriestic, palmitic,palmitoleic,stearic,oleic,linolic acid.		[16]
	Others- p insulin, Momordicine,charantin,polypeptideascorbigen.		[16]
Seed	Fatty acid and Proteins	contain essential fatty acids and proteins, contributing to the nutritional profile of bitter gourd.	[17]
	Amino acids-valine, threonine		[16]
	,methionine,isoleucine,leucine,phenyl alanine,glutamic acid		
Plant body	Momorcharines,momordenol,momordicilin,momodicins,momocardicinin,cucurbitis,erythrodiol,cucubitane s.		[16]

Table no.4: Ethnobotanical uses of Bitter gourd:[20]

Plant part	Type of extract	Ethanobotanical uses
Leaf	Leaves or Oral Hot water extract	Anti-helmintic, piles and jaundice; treatment of ringworm, bowel movement,congestion and chest pain,treatment of leprosy cough .
Veins and shoot	Hot water extract	shoots used to treat pneumonia.
Root	Decoction	Root paste administered in milk to reduce the scars in small pox and use as an Abortifacient.
Fruit	Fruit Juice	Used for jaundice,leprosy, diabetes, treatment of malarial fevers, Antihelminthic,in treatment of gout and rheumatism.
Seeds	Hot water extract or oral	Seeds are boiled and extreme bitter effusion use as vomiting inducer and reduces fat .

3) Cold Press Extraction:

Cold press extraction is a mechanical method used to extract oil from seeds and fruits without the application of heat, preserving the oil's nutritional and bioactive properties. This technique has gained popularity due to its environmentally friendly nature and the high quality of oil produced, which retains flavor, aoma, and beneficial compounds that may be lost in solvent extraction methods. The following sections detail the process, benefits, and applications of cold press extraction.[22]

-Crushing seeds or fruits to extract oil is known as cold pressing, and it usually takes place at temperatures lower than 50°C.

-Oil yield is strongly influenced by the moisture content of seeds; for example, Roman nettle seeds had their best oil yield at 5% moisture content

.

Nutritional and Bioactive components-

- Antioxidants, phytochemicals, and vital fatty acids are abundant in cold-pressed oils. For instance, tocopherols, phenolics, and high concentrations of linoleic and oleic acids are found in maize oil.[23]
- Because it contains carotenoids and capsaicinoids, the seed oil of Capsicum annuum is known to have a high level of antioxidant activity.[24][25]

Applications:

- Because of their anti-inflammatory and antibacterial qualities, cold-pressed oils are used in the pharmaceutical, cosmetic, and culinary industries. [25][26]
- The technique works especially well with seeds that have a lot of oil, like peppers and carrots, which are becoming more and more known for their positive health effects.[26]

Cold press extraction is mechanical extraction technique which require less energy for oil extraction as compared to other extraction techniques. Consumers are drawn to these oils because they are safe and natural, and because they include more lipophilic phytochemicals, such antioxidants, which help to prevent certain illnesses and enhance human health. In this method high quality oil obtained by applying low temperature heat, many heat sensitive phenolic compounds not degrade and no oxidation reaction occurs. The oil obtained by this process can be suitable for direct consumption and does not requires refining and further any other treatment.[27] Cold-pressed oil can be physically purified using filtration, sedimentation, or centrifugation techniques, which have no effect on the oil quality.[28]

The cold-pressed oils can be used as fatty acid supplements because of the valuable double bonded fatty acid and as natural antioxidant additives because of phytochemicals. There are numerous studies looking at the additional chemicals in the oils and their potential applications in food items.[27] Due to the low production costs and preservation of a high concentration of bioactive components such as essential fatty acids, tocopherols, phenols, carotenoids, and phytosterols in the oil, cold pressing is the process that producers and consumers choose for extracting seed oil.[28]

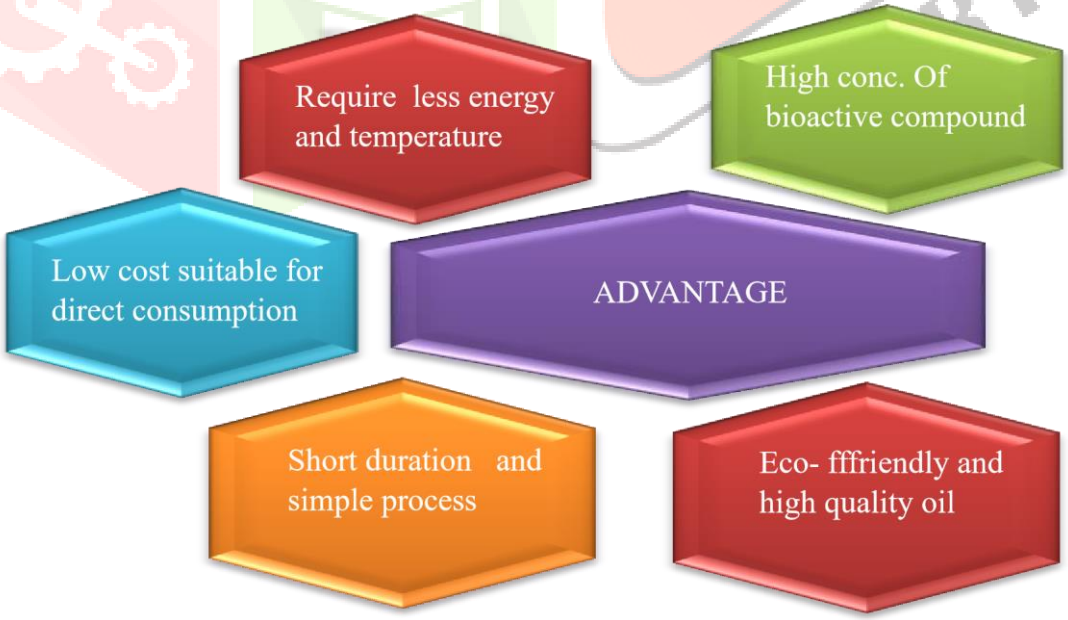


Fig no. 1: Advantages of cold press extraction.[27]

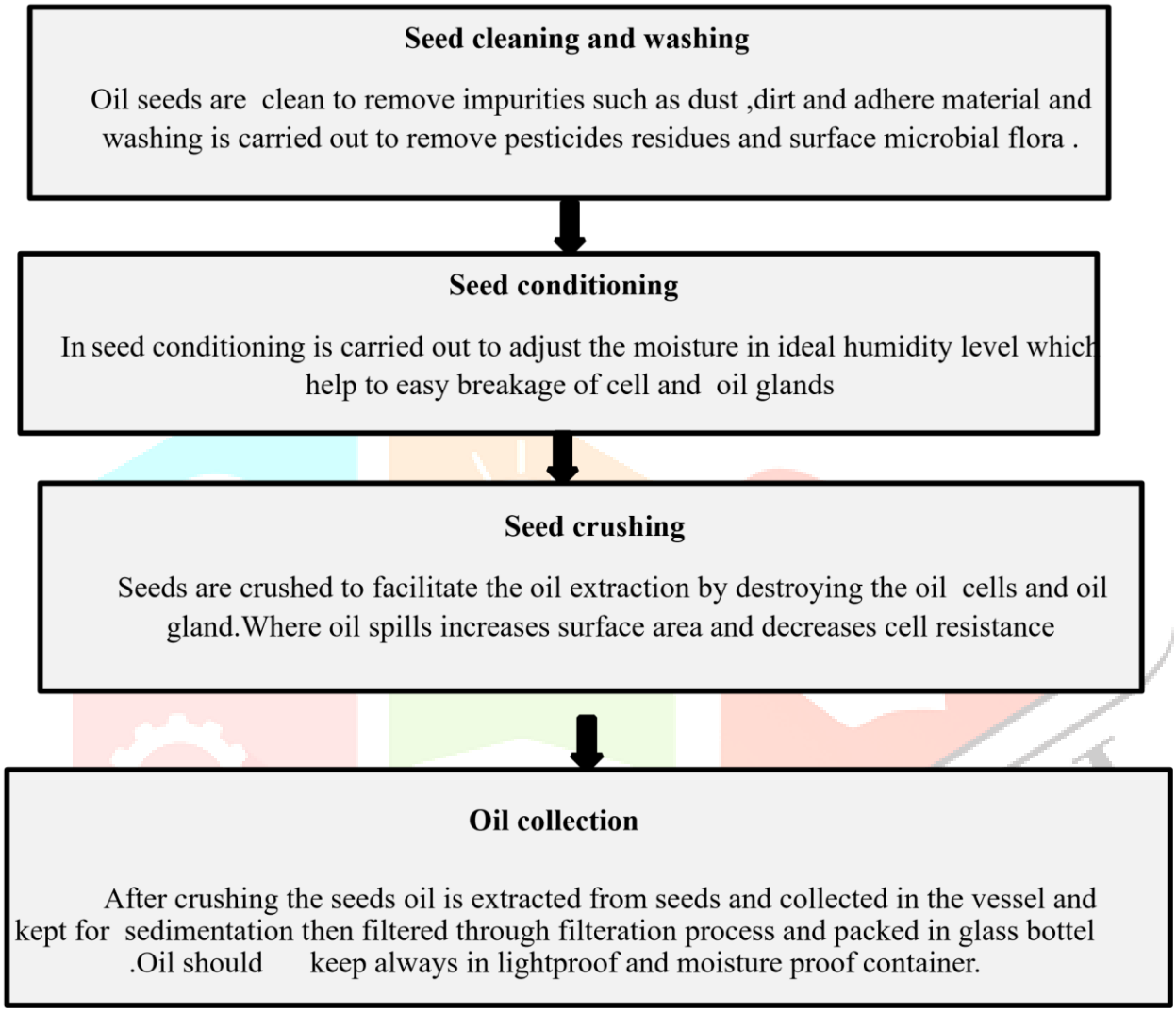
DISADVANTAGES[29]

1)yield is not high as solvent extraction technique .

2)higher level of turbidity

Fig no 2: process of cold press extraction

Process of cold press extraction[27]



The seeds are crushed or pressesd to squeeze the essential oil or juices and get centrifuged to remove or separate the soilds particles from oil or juice or kept for sedimentation and then filtered it.[30]

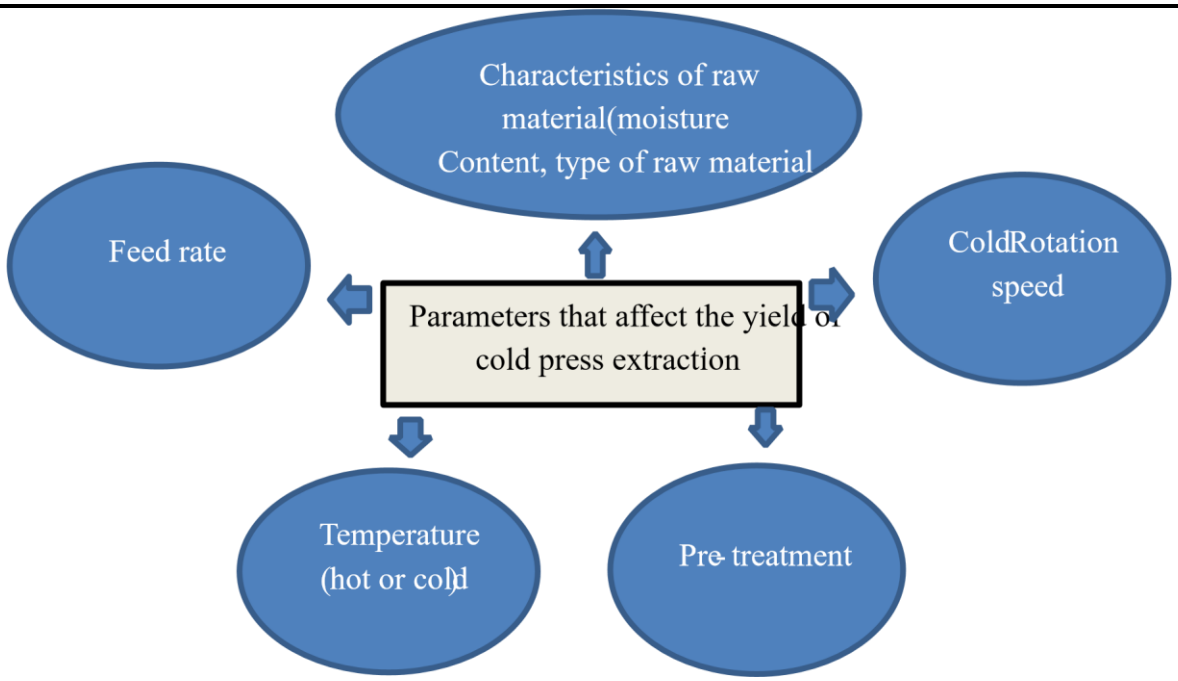


Fig.3- parameters that affect the yield of cold press extraction [27]

a wooden pestle and bulls, oil is extracted following the conventional manner. These days, there are power-operated cold press mills available, and hydraulic or screvw-type expeller presses with steel cooling systems are used to extract oil. This approach is reasonably simple and affordable.[28] a power operated cold mill press or machinery designed to extract oil from oil seeds or other parts of plant,Which increase the nutritional quality and enhance efficiency and yield of oil .

Efficiency and yield improvement

 Multistage processing [31]

- there is less fluid left in seed cake after using multistage processing Automation[32]

-use automated guided vehicles (AGVs) increase operational effectiveness

Table no 5:Properties and mechanism of action bitter gourd

Bitter gourd properties	**Formulation or products**	**Mechanism of action**	**Refrences**
In wound healing	Juice of bitter gourd	In inhibition of Leprosy	[13]
	Ointment of bitter gourd powder	In terms of wound closure time, wound-contracting ability, and epithelization duration, powder ointment has demonstrated a noteworthy reaction	

	1% w/v of 95% of absolute ethanol -50% of benzene Momordica fruit extract	Improved the rate of epithelization and wound closure.	
Anti hyperglycemic	Bitter gourd extracts:	It increases insulin senstivity by repairing damaged betacells	[13]
	Bitter gourd fruit aqueous extract : **Charantins** mainly present in fruit (insulin like peptide and alkaloids)	Short chain fatty acid inhibit glucose production by inhibiting glucose metabolism by GLUT4 transpoter inhibition by incresing blood free fatty acids	[15]
Anti hyperlipidimic activity	3 % of bitter gourd	Reduces triglycerides and cholesterol level by increasing feacal lipid excretion . bitter gourd contain Apo-A-1 protein which contain important content for HDL synthesis.	[13]
Anti oxidant activity	Ethanol and water extract of bitter gourd	Inhibit lipid peroxidation in foods.	[13]
Anti inflammatory activity	The hot water, 95% ethanol, and ethyl acetate extracts of Wild Bitter Gourd.	Show a peak decrease in inducible nitric oxide synthase (iNOS), pro-interleukin-1 β expression, and LPS-induced nitric oxide (NO) and prostaglandin E2 (PGE2) synthesis.	[20]
Anti viral activity	The leaf extract of bitter gourd	enhanced natural killer cell activity and interferon production, as well as an immunostimulant impact in both people and animals and a greater resistance to viral infections.	[20]
Anti tumour activity	a hot water extract of the entire plant	anti-carcinogens or chemopreventive agent and also act as immunomodulator	[20]

Table no.6: marketed formulations

Marketed Formulation	Main Chemical Constitents	Key Ingredients	Uses
Bitter gourd extract capsules	Charantin,Polypeptidep, Momordicin	Bitter gourd extract(concentrated), M agnesium stearate,gelatin,silicon dioxide	Helps lower blood sugar,improve insulin sensitivity,cholesterol control
Bitter Gourd Syrup	Charantin, polypptidep,vitamins (C ,B)	Bitter gourd extract,water,sugar\hone y	Blood sugar regulation:Reduces blood glucose. Digestive aid: Improve digestion alleviates constipation
Bitter Gourd Tea	Charantin,Flavonoids (Quercetin,Kaempferol), Polypheno ls	Dried bitter gourd,herbs(eg ginger,turmeric)	Digestive health:Eases bloating,suppose liver detox, Blood sugar management:Reegulat e blood glucose,Reduce inflammation
Bitter gourd powder	Charantin,PolypeptideP, Vitamins,Alkaloids	Dried bitter gourd ,herbs(Fenugreek,Turme ric or Ginger)	Control blood sugar level,Support liver and kidney health

Bitter Gourd Seed Oil	Fatty acids(Linoleic acid),Polyphenols	Bitter gourd seed oil	Moisturizes and nourishes the skin, treat acne,Promotes hair growth,prevent dandruff,Reducs wrinkles
Bitter Gourd Extract Cream	Momordicin,Alkaloids	Bitter gourd extract,cream base,Aloe vera,vitamin c,tea tree oil,neem extract,turmeric extract,Glycerin,Hyalur onic acid	Treats acne,eczema,psoriasis ,Reduces skin irritation and swelling,Fights skin infections
Bitter Gourd Juices	Charantin ,polyphenols,vitamins(A, C, B)	Fresh bitter gourd extract,water,flavorings(eg lemon)	Rehydrates and provides essential nutrients,Helps in controlling glucose ,Protects againsts oxidative stress

Conclusion :

Bitter gourd oil obtained by cold press is of high quality. Compared to other techniques, cold press extraction increases the yields of advantageous compounds by maintaining the integrity of the active ingredients. The extracted oil is rich in beneficial fatty acids, such as α-eleostearic acid, which has health benefits. Blood sugar lowering is one of the many health benefits of bitter gourd polysaccharides and peptides that are extracted using cold press techniques. Bitter gourd may help prevent gynecological cancer because it has shown strong anticancer activity against breast, ovarian, and cervical cancer cells. Bitter gourd contains flavonoids, alkaloids, tannins, saponins, and triterpenoids, which contribute to its antiinflammatory and fibrinolytic properties. These compounds enhance cellular regeneration and reduce inflammation, crucial for effective wound healing.

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