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PHYTOCHEMICALS PROFILING OF SELECTED CUCURBITACEAE FRUITS: CUCUMIS MELOVAR, CUCUMIS SATIVUS, AND CUCUMIS MELO

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Abstract
In the plant kingdom, Cucurbitaceae is medicinally and economically valuable and biggest family. It has greatest importance due to therapeutic potent. It has 130 genera and about 825 species. Some cucurbits, fruit and seeds parts contain, emetic, purgatives (prevent constipation) and antihelmintsics properties. Human nutrition mainly depends upon fruits and vegetables, which possess rich antioxidants. The family Cucurbitaceae includes crops like cucumbers and melons: i.e. Cucumis melovar (Kakri), Cucumis sativus (Khira) and Cucumis melo (Kharbuza) fruit which are medicinally essential. The family Cucurbitaceae plants jointly called cucurbits. Cucurbitaceae family plants have tremendous nutritional and medicinal benefits due to distinctive properties, the plants found active agents containing pharmacological activity. The main phytoconstituents are present in these fruits parts such as, terpenoids, glycosides, tannins, saponins, carbohydrates, cardiac glycosides, alkaloids, steroids, proteins and amino acids etc. A plant of the family has terpenoid substance, so it is known as Cucurbitacians.

Introduction:

Human nutrition is strongly supported by the consumption of fruits and vegetables, which play a vital role in maintaining overall health and preventing diseases (Karakurt et al., 2015). These natural food sources are rich in antioxidants such as phytosterols, phenolic compounds, and other bioactive phytochemicals that contribute significantly to human well-being (Shahidi et al., 2015). The presence of these compounds has been widely associated with the prevention and management of several chronic diseases, including hypertension, diabetes, cancer, cardiovascular disorders, and neurodegenerative conditions (Joseph et al., 2000; Ansari et al., 2013; Das et al., 2013; Uwa et al., 2017). Oxidative stress, caused by an imbalance between free radicals and antioxidant defenses, leads to molecular damage in lipids, proteins, and DNA. This process is primarily linked to mitochondrial respiration, where a small percentage of oxygen consumption results in the formation of reactive oxygen species (ROS) (Ramya et al., 2013; Shoaib et al., 2015; Ismail et al., 2010). In addition to endogenous sources, external factors such as pollution, smoking, and environmental toxins further enhance oxidative stress. Therefore, the inclusion of antioxidant-rich fruits and vegetables in the daily diet is essential to neutralize free radicals and reduce the risk of various diseases (Chang et al., 2018). Important antioxidant components in plants include carotenoids, polyphenols, anthocyanins, and vitamins, which play a crucial role in protecting biological systems. Among commonly consumed vegetables, cucumber is recognized as a source of antioxidant compounds, particularly carotenoids and phenolics (Chu et al., 2002). However, its antioxidant activity has been reported to be comparatively lower than other vegetables within the same category. Nevertheless, fruits and vegetables in general contain a wide range of phytochemical constituents such as flavonoids, tannins, alkaloids, glycosides, and coumarins, which exhibit strong antioxidant and pharmacological properties (Harith et al., 2018). These phytochemicals not only support the immune system but also help the body combat harmful agents and diseases (Ismail et al., 2010).

Natural plant-based compounds are increasingly preferred over synthetic drugs due to their safety, accessibility, and minimal side effects (Sahithi et al., 2015). Epidemiological studies have demonstrated a strong correlation between high fruit and vegetable intake and a reduced risk of chronic diseases. Conversely, low consumption of these food groups can lead to nutritional deficiencies and an increased likelihood of conditions such as cancer, cardiovascular diseases, and metabolic disorders (Mehra et al., 2015). It is estimated that more than 10,000 phytochemicals are present in plant-based foods, many of which contribute to antioxidant defense mechanisms by mitigating the harmful effects of ROS and reactive nitrogen species (Zhang et al., 2015). In food systems, antioxidants play a crucial role in delaying lipid oxidation and preventing the formation of undesirable compounds such as aldehydes, ketones, and organic acids (Saad et al., 2007; Marwa et al., 2016). Although synthetic antioxidants such as TBHQ, BHA, and BHT are widely used, their potential toxic and carcinogenic effects have raised concerns, emphasizing the need for safer natural alternatives (Ansari et al., 2013; Das et al., 2013; Uwa et al., 2017). The Cucurbitaceae family, which includes Cucumis melovar (Kakri), Cucumis sativus (Khira), and Cucumis melo (Kharbuza), is widely cultivated in tropical and temperate regions and is known for its nutritional and medicinal significance (Yasar et al., 2006; Sabrin et al., 2012). These cucurbit fruits are commonly consumed due to their low cost, availability, and health-promoting properties. They are rich in antioxidants and essential nutrients, making them valuable components of the human diet (Kumaraswamy, 2016). Traditionally, these plants have been used in the treatment of various ailments, including burns, wounds, respiratory disorders, diabetes, and skin diseases. They also exhibit pharmacological properties such as anti-inflammatory, antiseptic, and diuretic effects (Rajasree et al., 2016).

Furthermore, their traditional uses, cucurbit fruits are recognized for their diverse phytochemical composition, which contributes to their therapeutic potential. Previous studies have reported that these plants possess a wide range of biological activities, including antioxidant, antimicrobial, anti-inflammatory, and anticancer properties (Bidkar et al., 2012; Ru et al., 2018; Sahu et al., 2015; Vishwakarma et al., 2017). Furthermore, their nutritional value is significant, as they contain essential vitamins, minerals, dietary fiber, and bioactive compounds that support metabolic and physiological functions (Basit et al., 2017; Pulok et al., 2013; Chakravarty, 2017; Abbey et al., 2017; Bordbar et al., 2011; Roberts, 2018; Mello et al., 2001; Mian et al., 2007; Rashid et al., 2011; Dhaliwal et al., 2017; Mumeena et al., 2017).

Despite their importance, comprehensive studies focusing on the phytochemical composition of different fruit parts (pulp, peel, and seeds) using different solvents are limited. Therefore, the present study aims to qualitatively investigate the phytochemical constituents of Cucumis melovar, Cucumis sativus, and Cucumis melo using methanolic and hexane extracts. This research provides valuable insights into the distribution of bioactive compounds in different fruit parts and highlights their potential applications in food, pharmaceutical, and nutraceutical industries.

Materials and Methods

Extremely pure and analytical grade chemicals used in the experiments. Ferric chloride, Folin-ciocalteu reagent, anhydrous sodium carbonate, chloroform, sodium hydroxide, Mayer's reagent, methanol, glacial acetic acid, sulphuric acid, acetic anhydride, acetic acid, Molisch's reagent, ninhydrin, glacial acetic acid, ammonium hydroxide, diethyl ether, butanol, hydrochloric acid, sodium chloride, sodium carbonate, dimethyl sulphoxide, n- hexane, iodine solution and dimethyl sulphoxide.

Sampling:

The fruits were cleaned with fresh (distilled) water to eradicate dirt substances. Different parts of all fruits were separated and cut into fine small pieces. The sample materials were dried under shade for 15 days and ground into fine powder by grinding machine. After sieving 22 m.m, they were transferred to air-tight polyethylene zipper bags to protect from sunlight and air, labeled for further use.

Seed Peel Pulp

Fig:1 *Cucumis melovar* (Kakri) fruit parts

Seed Pulp Peel

Fig: 2 *Cucumis sativus* (Khira) fruit parts

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Seed Pulp Peel

Fig: 3 *Cucumis melo* (Kharbuza) fruit parts

Preparation of Extracts:

Dry powder (1 kg) of all parts (pulp, peel and seed) fruits *Cucumis melovar, Cucumis sativus* and *Cucumis melo* punched in 2 liters of crude methanol and shaken several intervals. Later 72 hours of soaking, they were purified with filter paper and filtrates were concentrated with the rotary vacuum evaporator on low pressure to get the rough methanol extract.

Remains were put off in 10% dimethyl sulphoxide and deposited to screen phytochemicals (Abbas, M, et al; 2013).

Fig: 4 Preparation of methanolic extracts in the laboratory

Fig: 5 Preparation of hexane extracts in the laboratory

Phytochemical screening of *C. melovar, C. sativus and C. melo* fruit parts:

When the extracts were achieved, the fluid was exposed to vacuum rotary evaporator to absorption and recover the solvent. Later determined extracts were dried to remove air and preserved for further analysis (Sahithi, G, et al; 2015).

Qualitative Analysis:

The dried extracts of pulp, peel and seeds of C. *sativus,* C. *melovar* and C. *melo* fruit in hexane and methanol were utilized to non-quantitative examination of many phytochemical constituents such as flavonoids, terpenoid, alkaloids, tannins, saponins, glycoside, cardiac glycoside, steroid and carbohydrate, proteins and amino acids.

1. Flavonoids (Alkaline reagent Test):

Put few drops of NaOH solution in 0.5 ml of dried extract. Deep yellow color developed and later the thinned HCl acid was mixed to the solution of alkaline, color vanished and it shows the occurrence of flavonoids (Arvin, B. P et al; 2014, Gaikwad, M, et al; 2018).

2. Saponins (Foam Test):

The 1 ml extract put in water free of ions and stunned well to yield foam that continued till 10 minutes, representing presence of saponin (Joseph, N, et al; 2018, Geetha, T.S; 2014).

3. Tannins ($FeCl_3$ Test):

The 0.5 ml of extract was put in the one ml of double distilled water and the little droplets of ferric chloride ($FeCl_3$) substance were added, greenish black color produced is the indicative of the existence of catecholic tannins (Rahim, G, et al; 2012, Gul, R, et al; 2017, Devi, M. K, et al; 2018).

4. Glycosides (Keller Killiani Test):

0.5 (half) ml of the dried extract was carried with glacial acetic acid. Solution of the substance was mixed with a few droplets of ferric chloride and thickened sulphuric acid. The 2 coatings of bluish green and reddish brown color appeared in upper coating at junction, it shows the existence of glycoside (Bhandary, K. S, et al; 2012, Gul, R, et al; 2017).

5. Alkaloids (Mayer's Test):

Put few droplets of reagent of Mayer's in the 0.5 ml extract. Due to that cream color appeared, showing the presence of alkaloids (Joy, G.S., et al; 2014).

6. Proteins and amino acids (Ninhydrin Test):

0.2% ninhydrin solution was added in crude samples extract and boiled, later purplish-blue color appears which is indicative of the existence of amino acids and proteins (Yadav, R.N et al; 2011).

7. Steroids (Liebermann-Burchard Test):

The 4 mg (0.04 g) sample was dissolved with 0.5 mg of acetic acid along with 0.5 ml of chloroform. The solution was added with concentrated sulphuric acid slowly, it formed bluish green color shows the occurrence of steroids (Zohra, S. F, et al; 2012).

8. Carbohydrates (Molisch's Test):

The 3 ml sample extract was mixed with 1 to 2 drop of Molisch's reagent, mixed well. The two liquids appearance of violent ring at the junction layer due to the accumulation of thickened H_2SO_4 in the substance indicated the presence of the sugars.

Iodine test: 0.5 ml extract mixed with 2 ml of iodine solution, the dark blue or purple color indicated the presence of carbohydrates (Wani, S. A., et al; 2013, Jardat, N, et al; 2015).

9. Terpenoids (Salkowski Test):

The (0.5) ml of the dried extract mixed with 2ml of chloroform along with thickened sulphuric acid. The change in color to brown reddish at the interface shows the existence of terpenoid (Dhandapani, R, et al; 2008, Harith, S. S, et al; 2018).

10. Cardiac glycosides (Keller-Kilani Test):

The 0.5 ml of dried extract was treated with glacial acetic acid holding 15 ml and one to two droplets of $FeCl_3$. It was added with one ml of thickened H_2SO_4. The production of chocolate ring at the surface shows the existence of cardiac-glycosides (DSD, S. J, et al; 2017).

Results and Discussion

Phytochemical screening: The qualitative phytochemical screening shows several phytoconstituents of *C. melovar, C. sativus* and *C. melo* fruit i.e. seed, pulp, peel in methanolic (CH_3OH) extracts were achieved together with amino acids, alkaloids, cardiac-glycoside, steroids, tannins, saponins, terpenoids, flavonoids, glycosides, carbohydrates and proteins (Awaad, A. S, et al; 2014, Sheila, et al; 2018) as displayed table no. 1, highlights the not existence of steroids in all three fruit extracts in accordance with the literature (Sahar, A, et al; 2013, Ndman, A, et al; 2014).
It was found that steroids were not present in the extract of fruits. The literature also supports the finding of the current study (Kumar, D, et al; 2010). It is because of the mineral composition, soil environmental change, and course of cultivation (Doughari, J. H, et al; 2007).

Table no:1
Phytochemical screening of *C. melovar* (Kakri) in methanolic solvent.

Sample 1	Tannins	Flavonoid	Alkaloid	Saponins	Steroid	Glycoside	Terpenoid	Cardiac Glycoside	Carbo hydrates	Protein& amino acid
Pulp	+	+	+	+	_	+	+	+	+	+
Peel	+	+	+	+	_	+	+	+	+	+
Seed	+	+	+	+	_	+	+	+	+	+

Fig: 6 Phytochemicals in methanolic extract of *Cucumis melovar*

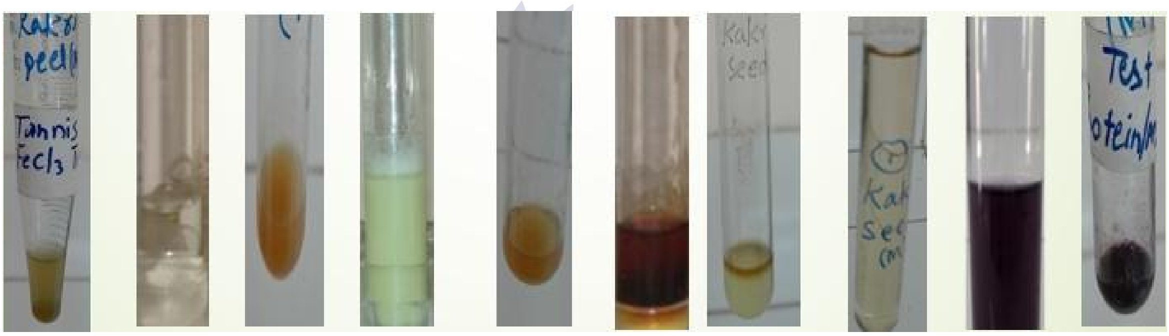


Table no:1 qualitative analysis of *C. melovar* fruit parts in methanolic extract shows the presence of tannins, saponins, alkaloids, glycosides, cardiac glycoside, terpenoid, carbohydrates, proteins and amino acids. My analysis indicated, steroid was not found in three fruit parts peel, pulp and seed.

Table no: 2
Phytochemical screening of *C. sativus* in methanolic solvent

Sample 1	Tannins	Flavonoid	Alkaloid	Saponins	Steroid	Glycoside	Terpenoid	Cardiac Glycoside	Carbo hydrates	Protein& amino acid
Pulp	+	+	+	+	_	+	+	+	+	+
Peel	+	+	+	+	_	+	+	+	+	+

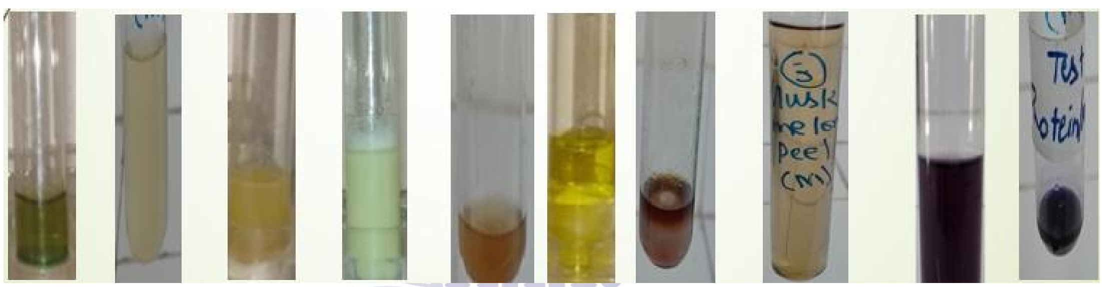
Seed	+	+	+	+	_	+	+	+	+	+

Fig: 2 Phytochemicals in methanolic extract of *Cucumis sativus*

My study shows in table no: 4.2 methanolic extract of C. *sativus* fruit parts indicates the tannins, flavonoides, saponins, alkaloids, glycosides, cardiac glycoside, terpenoids, carbohydrates, proteins and amino acids present in peel, pulp and seeds of C. *sativus.* But steroids absent in three fruit parts peel, pulp and seed.

Table: 3
Phytochemical screening of *C. melo* in methanolic solvent

Sample 1	Tannins	Flavonoid	Alkaloid	Saponins	Steroid	Glycoside	Terpenoid	Cardiac Glycoside	Carbo hydrates	Protein& amino acid
Pulp	+	+	+	+	_	+	+	+	+	+
Peel	+	+	+	+	_	+	+	+	+	+
Seed	+	+	+	+	_	+	+	+	+	+

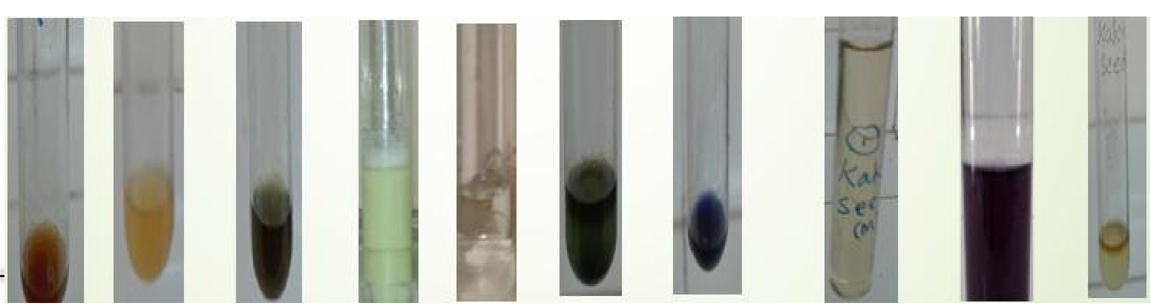
Fig: 3


Phytochemicals in methanolic extract of *Cucumis melo*

According to my analysis table no: 3 methanolic extract of C. *melo* appearances tannins, flavonoids, saponins, alkaloids, glycosides, cardiac glycoside, terpenoids, carbohydrates proteins and amino acids. But steroids absent in three fruit parts peel, pulp and seed

Table no: 4
Phytochemical screening of *C. melovar* in hexane solvent

Sample 1	Tannins	Flavonoid	Alkaloid	Saponins	Steroid	Glycoside	Terpenoid	Cardiac Glycoside	Carbo hydrates	Protein& amino acid
Pulp	_	_	_	+	_	+	_	+	+	_
Peel	_	_	_	+	_	+	_	+	+	_
Seed	_	_	_	+	_	+	_	+	+	_

Fig 4


Phytochemicals in hexane extract of *Cucumis melovar*

Table no: 5
Phytochemical screening of *C. sativus* in hexane solvent

Sample 1	Tannins	Flavonoid	Alkaloid	Saponins	Steroid	Glycoside	Terpenoid	Cardiac Glycoside	Carbo hydrates	Protein& amino acid
Pulp	–	–	–	+	–	+	–	+	+	–
Peel	–	–	–	+	–	+	–	+	+	–
Seed	–	–	–	+	–	+	–	+	+	–

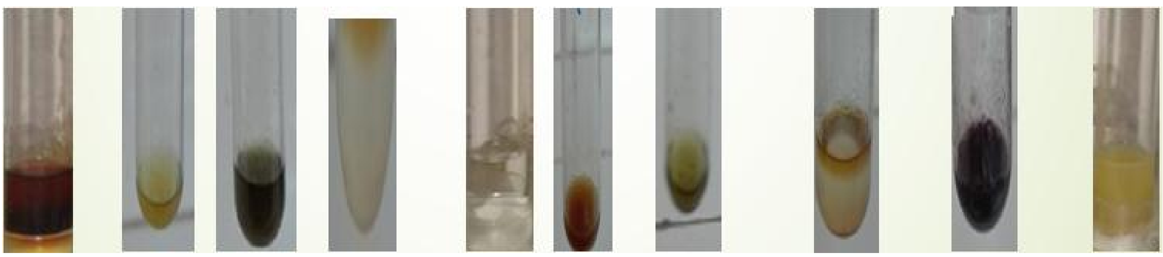


Fig: 5 Phytochemicals in hexane extract of C. *sativus*

Table no: 4, 5 and 4.6 show C. *melovar,* C. *sativus* and C. *melo* fruit parts (pulp, peel and seed) in hexane solvent contained no concentration of sub-constituents of phytochemicals such as flavonoids, alkaloid, tannins, steroids, terpenoids, proteins and amino acids but few phyto constituents such as saponins, glycosides, cardiac-glycoside and carbohydrates found in C. *melovar,* C. *sativus* and C. *melo* fruit parts.

Table no: 6
Phytochemical screening of *C. melo* in hexane solvent

Sample 1	Tannins	Flavonoid	Alkaloid	Saponins	Steroid	Glycoside	Terpenoid	Cardiac Glycoside	Carbo hydrates	Protein& amino acid
Pulp	–	–	–	+	–	+	–	+	+	–
Peel	–	–	–	+	–	+	–	+	+	–
Seed	–	–	–	+	–	+	–	+	+	–

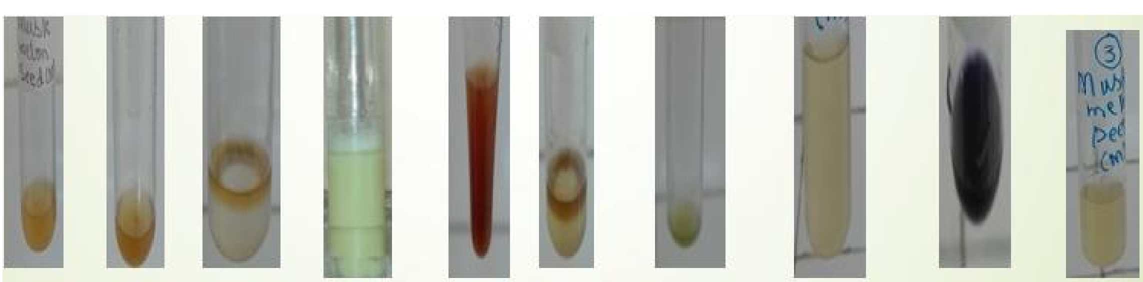


Fig: 6 Phytochemicals in hexane extract of *Cucumis melo*

The methanolic and n- hexane extracts seeds of the *C. melovar, C. sativus* and *C. melo* fruit parts contained tremendous anti - microbial, anthelmintic activity is beneficial in the vermifuge. The fruit peel extract is excellent source for the treatment of diabetics (Debnath. B, et al; 2015, Vishwakarma, et al; 2017).

Conclusion:

Pulp,seeds and peel of *C. melovar, Cucumis sativus,* and *C. melo* show phytochemicals more in methanolic extract through dark colors and hexane extract appear light colors than methanolic extracts. The fruit parts of the plants utilized in daily diet, they may support to inhibit from the syndromes affected by free radicals because of its therapeutic potential.

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