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Comprehensive Analysis of the Literature on Post-Culinary Waste Management Focuses on Cucurbitaceae Family

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ABSTRACT

Fruits and vegetables produce the most food waste worldwide. Up to one-third of fruits and vegetables' peels and skins are discarded during preparation and processing. India is ranked second in terms of fruit and vegetable output. This post-culinary waste can be managed by extracting it into a bio conservation energy and also used to make effective drugs on biological species. The study investigates the ***Cucurbita moschata*, *Cucurbita maxima*, *Cucurbita pepo L.*, *Citrullus lanatus T.*, *Cucumis melo L.*, *Lagenaria siceraria*, *Cucumis sativa*.** species shows different pharmacological activities. All the pharmacological activities are the prospect of transforming post-culinary waste into highly nutritious food additives or supplements. Cucurbits have strong root systems that grow in the top 12 inches and taproots that reach three feet, allowing them to efficiently use nutrients and water from the soil. The content of Carbohydrate content of *C. maxima, C. pepo, and C. moschata* meat ranged from 26.23 ± 0.20 g/kg raw weight to 42.39 ± 0.84 g/kg and 133.53 ± 1.44 g/kg. *C. maxima* contained considerably more carbohydrates in pulp and peel than *C. pepo* or *C. moschata*. *C. maxima* exhibited considerably higher protein levels in the pulp (11.31 ± 0.95 g/kg raw weight) and peel (16.54 ± 2.69 g/kg raw weight) than *C. pepo* and *C. moschata*. *C. pepo* seeds had considerably higher protein (308.8 ± 12.01 g/kg raw weight) compared to *C. maxima* (274.85 ± 10.04 g/kg raw weight). *C. pepo* and *C. moschata* meat have a low-fat content (0.55 ± 0.14 and 0.89 ± 0.11 g/kg raw weight, respectively). *C. pepo and C. moschata* peels exhibited similar fat content (4.71 ± 0.69 and 6.59 ± 0.41 g/kg raw weight, respectively). *C. maxima* seeds contain considerably higher fat (524.34 ± 1.32 g/kg raw weight) than *C. pepo* or *C. moschata* (439.88 ± 2.88 and 456.78 ± 11.66 g/kg raw weight, respectively). *C. pepo's* pulp and seeds had considerably less fiber and ash than *C. moschata* or *C. maxima*. *C. maxima* had the lowest moisture content, while all portions of *C. pepo* had the greatest.

Keywords - Fruit and vegetable peels, Waste materials, Pharmacological potential

I. INTRODUCTION

Fruits and vegetables produce the most food waste worldwide (45%) (Dias *et al.,* 2020). (del Pilar Sanchez-Camargo *et al.,* 2019) found that fruit waste, such as pulps, peels, seeds, and kernels, is mostly caused by the agriculture sector and the fruit and vegetable processing businesses. According to (Sulaiman *et al.,* 2022) and (Wei *et al.,* 2022), improper handling of fruit wastes and their increasing disposal led to contamination of the environment. According to (Malek *et al.,* 2007) Currently, up to one-third of fruits and vegetables' peels and skins are discarded during preparation and processing, creating "waste" and lowering the quantity of nutrients that may be extracted to their greatest potential. China is the world's largest producer of (kiwi fruit) *Actinidia deliciosa L.*, with an estimated 1.06 million tons produced year (Huang *et al.,* 2017). Table 1 Gowe, C (2015) has mentioned the waste of nature and production of it.

Commodity	Nature of waste	Production in tones	Approx. Waste In (%)
Pineapple	Core, skin	75.7	33
Banana	Peel	2378.0	35
Citrus	Rag, peel, seed	1211.9	50
Dragon fruit	Rind, seed	-	30-45
Guava	Peel, core, seed	565	10
Mango	Peel, seed	6987.7	45
Peas	Shell	107.7	40
Papaya	Rind, seeds	-	10-20
Potato	peel	-	15

Table 1: - Nature of potential fruit and vegetable losses and waste.

Considering that industrial areas using manufacturing processes takes only fruit pulps and liquids, an enormous quantity of seeds and peels get threw away. An enormous variety of crops, including fruits, vegetables, decorative plants, root vegetables, medicinal herbs, aromatic plants, spices, and plantation crops, may be grown in India because to its very diverse agro-climate. Globally, India is ranked second in terms of fruit and vegetable output. It is commonly known that throughout the production, processing, harvesting, and usage of agricultural goods, massive volumes of lignocellulose biomass are produced yearly. Among the many applications for the biomass generated are (i) as a low-cost biosorbent; (ii) as feedstock for the production of biochemical and biofuels; and (iii) as a substrate for the enzymatic and metabolite synthesis process. By using them to make goods with additional value, these residues will also be kept out of the environment and solid waste processing would be avoided. (Palma *et al.,* 2011) The *Musa sp.* banana, which belongs to the Musaceae family, grows in hanging clusters with three to twenty hands and over twenty fruits per hand. Fruits weigh around 125 g on average, consisting of 75% water and roughly 25% dry substance. About 30–40% (w/w) of fresh banana is included in banana peel. With 16% of all fruits produced globally, bananas are the second most produced fruit. With a share of 27% of the global banana crop, India is the world's biggest grower (Wadhwa *et. al.,* 2013–14). Approximately 30–40% (w/w) of fresh banana is included in banana peel. Ripe blood plumes consist of the following components: ether extract (6.2%), soluble sugars (13.8%), crude protein (8%), and total phenolic compounds (4.8%). (Silva *et. al*., 2013) Low-molecular weight substances including as pectin, cellulose, hemicellulose, and chlorophyll are the major constituents of BP. According to (Turner T and Burri B 2013), citrus fruits and their derivatives are widely consumed worldwide and are still produced in large quantities. Tangerines, oranges, lemons, grapefruits, limes, mandarins, pomelos, kumquats, and other fruits are among them. According to Gowe (2015) in table 2, it is mention that waste part also contains phenolic compounds which are useful.

Commodity	Waste part	Phenolic compounds
Banana	Peel	Carotenoids
Citrus Fruits	Peel, Solid residues	Eriocitrin, hesperidin, naringin
Kiwi	Peel	Caffeic acid, protocatechuic acid, p-coumaric acid
Carrot	Pomace	Carotene (α and β)
Potato	Peel	Chlorogenic, gallic, protocatechuic and caffeic acid, chlorogenic acid isomer II

Table 2- Phenolic compounds present in some fruit and vegetable wastes.

Though the rind has a high nutritional content, it is usually dried, combined with dried pulp and fed to cattle (Zema *et al.,* 2018, and Bocco *et al.,* 1998) or thrown away and handled as waste, making up half of the fruit's original weight (Anagnostopoulou *et al.,* 2006 and Marín *et al.,* 2007). (de Moraes Barros *et al.,* 2012) consider this to be a possible source of contamination to the environment. We are now approaching "waste" or byproducts as potential components with additional value in novel and inventive ways. Made from banana, apple, and carrot peel powder, it is high in fiber and loaded with bioactive compounds. (Kohajdova *et al.,* 2009) assert that adding fiber to biscuits improves both their nutritional content and acceptability. Adjusting the percentage of fiber content in staple meals can help you achieve these benefits. During the pre- and post-harvest phases, a variety of waste products are created after fruits and vegetables are consumed. Usually, the created garbage is disposed of in dump yards, where it endangers the environment. Despite this, recent studies have shown that fruit and vegetable peel waste contain a wide range of bioactive substances, such as vitamin C, essential oil, ellagitannins, carotenoids, flavonoids, phenolics, and tannins (Pathak, 2020).

II. CUCURBITACEAE FAMILY: VEGETABLE RICH FAMILY

Taxonomical Description

Content	Description
Kingdom	Plantae
Division	Magnoliophyte
Class	Magnoliopsida
Order	Cucurbitales
Family	Cucurbitaceae

The Cucurbitaceae family can also be referred to as the pumpkin, melon, or gourd family. A total of 825 species and 120 genera in this family, the majority of which originate in the world's warmer climates. From (Davis *et al.,* 2008) Cucurbitaceae Family includes many vegetable gourds, such as *Lagenaria siceraria* (bottle gourd), *Citrullus lanatus* (watermelon), *Cucumis sativus* (cucumber), *Cucumis melo* (melon), *Cucumis anguria* (bur gherkin), Cucurbita (five species of squash & pumpkin), *Momordica charantia* (bitter melon), *Momordica dioica* (spine gourd), *Sechium edule* (chayote), *Luffa acutangula* (ridge gourd), *Benincasa hispida* (wax gourd), *Trichosanthes anguina* (snake gourd), *Trichosanthes dioica* (pointed gourd), Telfairia (two species of oyster nut), *Sicana odorifera* (casabanana), *Coccinia grandis* (ivy gourd), *Praecitrullus fistulosus* (tinda), *Cyclanthera pedata* (slipper gourd) and *Cucumeropsis mannii* (white-seeded melon). Curried for its nutritional and therapeutic properties, plants of the Cucurbitaceae family make up the majority of economically significant domesticated species. The genera *Ecballium, Citrullus, Luffa, Bryonia, Momordica, Trichosanthes, Cucurbita, and Cucumis* are the most important with more than thirty species. (Khare, 2004).

III.CHEMICAL CONSTITUENTS

The Family cucurbitaceae, which is found in tropical Asia and other noteworthy species are distributed across the world (The Wealth of India). The pointed gourd's potential has been proved by its fruit's minerals (magnesium, sodium, potassium, copper, and sulfur), vitamins, tannins, saponins, alkaloids, glycosides, flavonoids, steroids, pentacyclic triterpenes, and other bioactive components. Various phytochemical is found in the cucurbits play a major role in antioxidant and other assay. In some cucurbits, Alkaloids are absent as it represents different assay. So, according to the phytochemicals they show different assay presence. Muskmelon, watermelon, pumpkin, and squash generally accumulate in the vegetation and fruit 145 to 160 lbs nitrogen (N), 30 to 45 lbs phosphate (P_2O5) and 160 to 180 lbs potassium (K_2O) per acre. The content of Carbohydrate content of *C. maxima*, *C. pepo*, and *C. moschata* meat ranged from 26.23 ± 0.20 g/kg raw weight to 42.39 ± 0.84 g/kg and 133.53 ± 1.44 g/kg. *C. maxima* contained considerably more carbs in its meat and peel than *C. pepo* or *C. moschata. C. maxima* exhibited considerably higher protein levels in the meat (11.31 ± 0.95 g/kg raw weight) and peel (16.54 ± 2.69 g/kg raw weight) than *C. pepo* and *C. moschata. C. pepo* seeds had considerably higher protein (308.8 ± 12.01 g/kg raw weight) compared to *C. maxima* (274.85 ± 10.04 g/kg raw weight). *C. pepo* and *C. moschata* meat have a low-fat content (0.55 ± 0.14 and 0.89 ± 0.11 g/kg raw weight, respectively). *C. pepo* and *C. moschata* peels exhibited similar fat content (4.71 ± 0.69 and 6.59 ± 0.41 g/kg raw weight, respectively). *C. maxima* seeds contain considerably higher fat (524.34 ± 1.32 g/kg raw weight) than *C. pepo* or *C. moschata* (439.88 ± 2.88 and 456.78 ± 11.66 g/kg raw weight, respectively) ($P < 0.05$). *C. pepo*'s meat and seeds had considerably less fiber and ash than *C. moschata* or *C. maxima* ($P < 0.05$). C. maxima had the lowest moisture content, while all portions of *C. pepo* had the greatest.

Phytoconstituents	Chloroform extract	Ethanol extract	Aqueous extract
Alkaloids	-	+	-
Glycosides	+	-	-
Tannins and Phenols	-	+	-
Flavonoids	-	+	+
Steroids	-	+	-
Proteins and amino acid	-	+	+

Phytoconstituents	Chloroform extract	Ethanol extract	Aqueous extract
Carbohydrate	+	+	+
Fats	+	-	-

Present (+), Absent (-)

Table 3: Phytochemical Screening of Cucurbits family in different aqueous solution

Pharmacological Studies

Antioxidants are substances that aid in delaying the oxidation of macromolecules and shield cellular structures from harm brought on by free radicals (Fukumoto *et. al.,* 2000). In contrast, plant polysaccharides are made up of a variety of sugars and have been discovered to be effective as functional components in food and medicinal goods (Kpodo *et al.,* 2017). According to (Kpodo *et al.,* 2018), polysaccharides have bioactive qualities that are of used in various aspects and have interest in pharmaceutical companies. These features include anti-oxidative, anti-diabetic, anti-glycation, anti-tumour, anti-coagulant, anti-proliferative, and immunomodulatory effects.

IV. PHYTOCHEMICAL COMPOSITION OF SEVERAL CUCURBITACEAE SPECIES.

A significant source of phytochemicals is the Cucurbitaceae family. Phytochemicals may be extracted from fruit and vegetable waste with ease, and vegetables in this family generate a lot of trash. A few plants are selected to examine the quantity of phytochemicals generated by the Cucurbitaceae family.

1. *Cucurbita moschata* (**Squash**)
2. *Cucurbita maxima* (winter squash/ Pumpkin).
3. *Cucurbita pepo L.* (**summer squash**. / zucchini)
4. *Citrullus lanatus T.* (watermelon)
5. *Cucumis melo L.* **(muskmelon)**
6. *Lagenaria siceraria* (Bottle guard/ **Calabash**/ white-flowered gourd)
7. *Cucumis sativa* (Cucumber)

***Cucurbita moschata* (Squash) and *Cucurbita maxima* (winter squash/ Pumpkin)**

Species which are wide known in Cucurbitaceae family is high in antioxidant activity. (Suwannapong *et al.*, 2023) studies suggest the antidiabetic potential of fruit pulp extracts *from C. moschata* and *C. maxima* to provide information on the underlying mechanisms that underlie the pumpkin's antioxidant and antidiabetic qualities. According to (Chen *et al.,* 1994), pumpkin

has been shown to lower blood glucose levels in type 2 diabetes individuals. Total flavonoid content (TFC) is (20.81 ± 0.09 mgCE/g) and total phenolic content (TPC) is (5.27 ± 0.31 (mgGAE/g) for *C. moschata*. Also, the total flavonoid content (TFC) of *C. maxima* is (55.08 ± 2.21 mgCE/g), while the total phenolic content (TPC) was found to be 11.22 ± 0.19 mgGAE/g. The results of the DPPH experiment showed that *C. moschata* had a less powerful scavenging DPPH radical than *C. maxima*, with an IC_{50} of 13.69 ± 0.45 and 8.03 ± 0.95 µg/mL, respectively. Using the FRAP assay, it was shown that *C. moschata* showed less antioxidant activity by reducing Fe2+ than EC50 of *C. maxima* did, with 31.23 ± 3.15 vs. 42.67 ± 0.77 mMFe2+/g, respectively. But, *C. moschata* and *C. maxima* possessed a relatively low antioxidant activity when compared to ascorbic acid (0.01 ± 0.02 µg/mL). By using the DPPH and FRAP experiment, PCMOS and PCMAX demonstrated concentration-dependent antioxidant activity. TPC and TFC values for PCMOS were 5.27 ± 0.31 vs. 11.22 ± 0.19 mgGAE/g and 20.81 ± 0.09 vs. 55.08 ± 2.21 mgCE/g, respectively, lower than those for PCMAX. Compared to PCMOS, PCMAX has stronger antioxidant and antidiabetic properties. Cucurbits in the Cucurbitaceae family are among the foods whose antidiabetic qualities have been reported

(Jia *et al.,* 2003). In traditional medical systems, pumpkin has been utilized. According to (Kirtikar *et al.*, 2003), it has a variety of pharmacological activities, including antidiabetic, anticancer, antihypertensive, antioxidant, anti-inflammatory, antihyperlipidemic, antimicrobial, and immunomodulatory.

Samples	DPPH Assay IC_{50}(μg/ml)	FRAP Assay (mMFe^{+2}/g)	TPC (mgGAE/g)	TFC (mgCE/g)	Reference
Cucurbita moschata	13.69+-0.45	31.23+-3.15	5.27+-0.31	20.81+-0.09	Suwannapong *et al.*, 2023
Cucurbita maxima	8.03+-0.95	42.67+-0.77	11.22+-0.19	55.08+-2.21	Suwannapong *et al.*, 2023
Ascorbic acid	0.01+-0.02	-	-	-	

Table 4: Antioxidant activity of *p. moschata* and *p. maxima* using DPPH, FRAP, TPC and TFC.

Cucurbita pepo L. (summer squash. / zucchini), _Citrullus lanatus T._ (watermelon) and _Cucumis melo L._ (muskmelon)

Member of the Cucurbitaceae family, *Cucurbita pepo L., Cucumis melo L., and Citrullus lanatus T.* are farmed for their seeds. From the waste part of this species the separation of the pulp, the flesh, and seeds from the fruit, which results in the physicochemical and functional characteristics of the pulp and pectin extracts from the Cucurbitaceae family of plants. According to (Koštalov ́a ́ *et al.,* 2013), 90% of the fresh fruit is reported to consist of biomass. The watermelon rind extract has antibacterial and antioxidant qualities, due to the presence of polyphenols. At (4.2 mg GAE/100 g), the antioxidant activity of methanolic seed extract was found to be approximately 61% higher than that of rind extract and approximately 107% lower than that of peel extract. As per (Olude *et al.,* 2022), the ethanolic extract was analysed using the appropriate techniques, DPPH radical scavenging and FRAP, to ascertain its antioxidant activity as well as its qualitative and quantitative phytochemical composition. The contents of *C. lanatus* extracts were determined to include phenols (60.37 mg/100 g), flavonoids (78.36 mg/100 g), cardiac glycosides (32.76 mg/100 g), tannins (43.91 mg/100 g), saponins (40.35 mg/100 g), and reducing sugars (43.20 mg/100 g). Remarkably, the *C. lanatus* seed extract did not contain any alkaloids. Their total antioxidant capacity was ~35 mg/100 g. The study of three species' antioxidant activity, the DPPH (%) values for *Cucurbita pepo* L., *Cucumis melo* L., and *Citrullus lanatus* T. are (40.0±0.3), (50.0±0.2), and (43.0±0.2), respectively. The comparable FRAP (mg mL– 1) values for *Cucurbita pepo L., Cucumis melo L., and Citrullus lanatus T.* are (0.2±0.0), (0.4±0.0), and (0.2±0.0), respectively. According to DPPH and ABTS tests, the pulp of *Cucumis melo L.* exhibited the greatest level of antioxidant activity. As compared to the stated value for *Citrullus lanatus* (41.5%) (Neglo *et al.,* 2021), the results of the ABTS assay (63–85%) were substantially different ($p<0.05$) and lower than those obtained for watermelon fruit peel extracts (91%) (Neglo *et al.,* 2021). The Cucurbitaceae extracts' total polyphenolic content (TPC) ranged from (6.6 to 15.5 mg GAE/100 g). Overall, the levels are often less than the studied values for watermelon (29.3 mg GAE/100 g) and muskmelon (16.7 mg GAE/100 g) (Shofian *et al.,* 2011). According to (Maseko et al., 2019) and (Tapas *et al.,* 2008), TFC flavonoids are also known to have biological properties including anti-inflammatory, anti-carcinogen, and antioxidant properties. *Cucumis melo L.* and *Cucurbita pepo L.* have similar flavonoid contents ($p>0.05$). The outcomes were not satisfied as those reported for the *C. moschata* pulp (0.3 mg CE/mg) (Enneb *et al.,* 2020). In comparison to *Cucumis melo L.*, which had the highest value, *Cucurbita pepo L.* and *Citrullus lanatus* T. did not vary substantially ($p>0.05$) in their ability to reduce ferrous iron. The Cucurbitaceae pulps yielded FRAP values ranging from 0.2 to 0.4 mg mL–1, which was considerably less than the amounts documented for defatted and undefatted white melon seed flour

(1.0 and 1.5 mg mL−1, respectively) (Ijarotimi *et al.,* 2022).

***Lagenaria siceraria* (Bottle guard/ Calabash/ white-flowered gourd)**

Bottle gourds, or *Lagenaria siceraria*, are a kind of medicinal plant that are extensively grown in Asian and African nations. Ayurvedic Pharmacopoeia recognizes it as official. Traditionally, it has been utilized as a nutritional agent with properties such as diuretic, aphrodisiac, cardioprotective, cardiotonic, general tonic, antidote to certain poisons, scorpion strings, and alternative purgative. Pectoral cough, asthma, and other bronchial problems are treated with it, along with discomfort, ulcers, and fever. Additionally, it possesses a variety of biological properties, including anthelmintic, hepatoprotective, antibacterial, antihyperlipidemic, antihyperglycemic, analgesic, and anti-inflammatory properties. The aqueous extract in the aerial portion had the highest FRAP, whereas the ethyl acetate extract had the lowest. The pulp's ethyl acetate extract had the highest FRAP, whereas the acetone extract had the lowest. The acetone extract in the peel had the highest FRAP, whereas the toluene extract had the lowest. There was a clear relationship between FRAP and phenol content. The biggest amount of phenol and the highest FRAP activity were found in the peel acetone extract. For DPPH activity sample after the reaction mixture (1.0 ml) of 1.0 ml methanol, 1.0 ml DPPH (0.3 mM), and 1.0 ml of solvent extracts of various concentrations of *Lagenaria siceraria* diluted by methanol of the three components pulp, peel, and aerial part that were assessed, the peel had the highest phenol concentration, and the peel's ethyl acetate extract had the highest phenol content (IC_{50} = 117 μg/ml) and the highest DPPH activity. The findings provide credence to the widely held belief that phenolic content and antioxidant activity are directly correlated, so demonstrating the significant role phenols play in the health benefits of medicinal plants. (41, 44) The method provided allowed for the determination of the ABTS radical cation scavenging activity of several solvent extracts of *Lagenaria siceraria*. Only the peel extracts in acetone and ethyl acetate showed signs of ABTS activity. The pulp and aerial sections of *Linum siceraria* did not exhibit any ABTS activity in any of the solvent extracts. For both solvent-extracted peel samples, the IC_{50} value was 39 μg/ml. The antigiardial activity of *L. siceraria* was assessed by (Elhadi *et al.,* 2013). According to the findings, *L. siceraria* petroleum ether extract revealed 100% mortality in 72 hours at an IC_{50} of 95.65 ppm. From 135 to 163 mg TAE/g of extract, total phenolics were found. In leaf ethanolic extract (195.15 ± 11.64 mg TAE/g extract), the maximum phenolic content was observed. In fruit, on the other hand, the range is 72–111 mg TAE/g extract; nevertheless, acetone extract has the greatest phenolic concentration (111.18 ± 1.21 mg TAE/g extract). On the other hand, (Agrawal and katare 2015) found that the fruits of *L. siceraria* had a relatively small level of phenolics (11.9 ± 2.2 TAC unit). & (Mohan *et al.,* 2012) found a somewhat elevated concentration (233.4 ± 3.0 mg TAE/g extract) in the ethanolic fruit extract. Comparably, the total phenolics from the seeds of *L. siceraria* (141.35 ± 24.80 mg GAE/100 g DW) and *Citrullus colocynthis* (202.80 ± 7.50 mg GAE/100 g DW) were reported according to Sabo et al., 2014. The material under study had a greater TPC concentration than *Diplocyclos palmatus*, according to (Attar and Ghane, 2017) The antioxidant family of compounds in TFC known as flavonoids scavenges free radicals. They play a prophylactic effect in the development of cardiac and neoplastic disorders. (Smita *et al.,* 2009) According to the study, the maximum number of flavonoids were found in the ethanol leaf extract (76.62 ± 0.34 mg CE/g extract), whereas the highest quantity was found in the fruit (50.63 ± 1.59 mg CE/g extract) in the acetone extract. According to findings, the wild bottle gourd's fruit extract had a greater flavonoid concentration than ethanolic. (Shah *et al.,* 2010) The number of flavonoids in the bitter melon acetone extract was lower than what measured. (Badmanaban R. and C. Patel, 2010). It has been shown that the methanol extract of *Lagenaria siceraria* aerial parts possesses antihyperglycemic action and is intended for use in the treatment of diabetes. Additionally, it has been proposed that the plant has laxative, cardioprotective, diuretic, hepatoprotective, hypolipidemic, central nervous system stimulant, anthelmintic, antihypertensive, immunosuppressive, analgesic, adaptogenic, and free radical scavenging properties.

***Cucumis sativa* (Cucumber)**

According to (Sahu T and Sahu J. 2015), cucumber plants also exhibit a variety of pharmacological properties, including cytotoxic, antacid and carminative, hypoglycaemic, hypolipidemic, and antibacterial properties. Chemicals such as alkaloids, glycosides, steroids, flavonoids, saponins, and tannins were detected by phytochemical screening of an acetone extract obtained from cucumber leaves (Tuama AA and Mohammed AA, 2019). However, total flavonoids were found to be 0.36% (w / w) in quantitative analysis using spectrophotometry, total phenols to be 0.40% (w / w), and tannins were found to be 2.82% (w / w) in titrimetric study. Additionally, cucumbers contain β-carotene, as determined by a Thin-Layer Chromatography (TLC) scanner, with a result of 2.28% (Mandey *et al.,* 2019). (Saidu AN. Et al., 2014) reported that a phytochemical examination of cucumber pulp methanol extract revealed the presence of tannins, glycosides, phenolics, terpenes, alkaloids, and flavonoids. To prove that it is also used to treat diabetic patient, research has been done to identify the finding. According to Saidu (2014) Alloxan-induced diabetic rats received an oral dose of up to 500 mg/kg body weight of cucumber pulp methanol extract. The blood glucose concentration dropped dramatically with this extract, from 231.25 ± 1.11 (mg/dL) to 82.25 ± 1.55 (mg/dL). The blood glucose concentration was found to be considerably lower when glibenclamide, a typical antidiabetic medication, was administered orally at a dose of 5 mg per kg body weight. The blood glucose concentration reduced from 189.00 ± 2.42 (mg/dL) to 61.00 ± 2.48 (mg/dL). In light of this, shown that the methanol extract of cucumber pulp has hypoglycaemic active ingredients and may be utilized to treat diabetes mellitus (Saidu *et al.,* 2014). Following a nine-day treatment period, the hydroalcoholic extract (22.5-33.8%) and butanol extract (26.6-45.0%) of cucumber seeds shown significant reductions in blood glucose levels and management of weight loss in diabetic rats. After nine days of therapy, glibenclamide can lower blood glucose levels in both diabetic and normal rats (27.8–31.0% and 36.0-50.0%, respectively). According to the findings (Minaiyan *et al.,* 2011), the hydroalcoholic and butanol extracts of cucumber seeds successfully lower blood glucose levels in diabetic rats.

V. PHYTOCHEMICAL ESTIMATION AND ANTIOXIDANT POTENTIAL OF CUCURBITACEAE

As per the Qualitative research on TPF and TFC on multiple Cucurbitaceae species mentioned in Table 5, *Cucumis melo* L. has the highest total phenolic content in the aqueous solution, measuring 145.84±25.99 μg/ml, while *Cucurbita moschata* has the lowest total phenolic content, measuring 5.27±0.31 μg/ml. The total flavonoid content of *Cucumis melo* L. in an aqueous solution has the greatest phenolic concentration at 243.18±34.78 μg/ml. Table 6 shows that *Cucumis melo* L. had the lowest DPPH activity and *Lagenaria siceraria* had the highest, at 711. *Cucurbita moschata* exhibited more FRAP activity than *Cucumis sativa*.

Species	TPC	TFC	Reference
Cucurbita moschata	5.27 ± 0.31	20.81 ± 0.09	Kulczyński et. al., 2020
Cucurbita maxima	13.92 ± 1.49	3.79 ± 0.51	Singh et. al., 2016
Cucurbita pepo L.	32.6±0.17	80.5±0.02	Chigurupati et. al., 2021

Species	TPC	TFC	Reference
Citrullus lanatus T.	16.7	29.3	Shofian et. al., 2011
Cucumis melo L.	145.84±25.99	243.18±34.78	Muhamad et. al., 2018
Lagenaria siceraria	110.43±4.05	26.47±2.16	Patel et. al., 2018
Cucumis sativa	19.16±1.07	3±0.38	Yunusa et. al., 2018

Table 5: - Quantitative analysis of TPC and TFC of Cucurbitaceae species.

From the given table 5 cucurbits species, *Cucumis melo* L. show highest Total Phenolic Content which is way higher than *Cucurbita moschata*. According to the table, different species have different content of phytochemical which plays a major role. And similarly, *Cucumis melo* shows highest Total Flavonoid Content which is relatively much lower in *Cucumis sativa.*

Species	FRAP Assay	DPPH Assay	Reference
Cucurbita moschata	339.61±73.79	122.83±26.15	Kulczynski et. al., 2020
Cucurbita pepo L.	330.37±104.83	120.07±26.68	Kulczynski et. al., 2020
Citrullus lanatus T.	58.53±1.35	41.38±1.04	Jibril et. al., 2019
Cucumis melo L.	30.77	15.60	Gopalasatheekumar & Kalaichelvan (2021)
Cucurbita maxima	2.66	212.87	Kanupriya & Arihara 2019
Lagenaria siceraria	196.0±3.18	711	Patel et. al., 2018
Cucumis sativa	0.06±0.01	20.18±6.07	Yunusa et. al, 2018

Table 6: - Antioxidant Activity of Peel and Seed of different Species of Cucurbitaceae.

According to Table 6, FRAP Assay species named *Cucurbita moschata* has highest absorbance which is quite similar as of *Cucurbita pepo* L. And in DPPH Assay *Lagenaria siceraria* has the highest scavenging activity.

VI. CONCLUSION

This study highlights the value of frequently eaten fruit byproducts for pharmacological, therapeutic, and nutritional purposes. Numerous nutritional, therapeutic, and pharmacological properties were clearly present in this post-culinary waste. Additionally, several by-products have demonstrated anticancer and antidiabetic and other activities in both in vitro and in vivo changes. Through which it is possible to manage peels, pulp and seeds and other post-culinary waste. It is important to look into the process behind these qualities in more detail. Since cancer and diabetes account for thousands of deaths annually, research on the potential uses of these byproducts may prove useful in the future. The field of using fruit and vegetable post-culinary waste to produce anticancer, anti-inflammatory, antimicrobial, antidiabetic, high-nutrient foods or supplements have great promise, as these post-culinary waste products have high value and may be cheaply recovered.

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