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AN OVERVIEW: NUTRITIONAL, PHYTOCHEMICAL AND PHARMACOLOGICAL ASPECTS OF HIBISCUS CANNABINUS L.

Nilesh Patil*, Vanita Kanase, Nayan Karjavkar, Viraj Darade and Ram Patil

Konkan Gyanpeeth Rahul Dharkar College of Pharmacy and Research Institute, Karjat, Maharashtra, India.

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***Corresponding Author**
Nilesh Patil
Konkan Gyanpeeth Rahul Dharkar College of Pharmacy and Research Institute, Karjat, Maharashtra, India.

ABSTRACT

Kenaf (Hibiscus Cannibinus L) is a medicinal popular plant in the world. Pharmacological activities of kenaf have been investigated, which has indicated that kenaf plant has a wide range of therapeutic potentials as an antihyperlipidemic, antimicrobial, anti-inflammatory, anticancer, antioxidant, antityrosinase, hepatoprotective, and antiulcer agent. This article reviews traditional uses, nutritional and phytochemical constituents, and pharmacological effects of the Kenaf plant.

KEYWORDS: Hibiscus cannabinus, kenaf, Methionine, Cholesterol, Antityrosinase, Anthocyanins.

1. INTRODUCTION

Kenaf (Hibiscus cannabinus) is a common herbaceous dicotyledonous plant. Along with members of the cotton and okra families, Kenaf belongs to the Malvaceae family. It is present throughout Asia and Africa and mainly grows in temperate to tropical regions.[1,8] Kenafcan grow with high biomass production and reaches around 5 m in 6 to 8 months under suitable climatic conditions, producing around 30 $t.ha^{-1}$ of dry stem material.[9,10] In recent years, the production of kenaf was dominated by Thailand, India, and China, while the portion of other nations was relatively small.[11] In conventional medicine, Kenaf treats multiple diseases; for example, In Africa, anaemia and guinea worm illness are treated with a paste made from leaves and stems.[2] Kenaf (leaves and seed) is highly regarded for its important pharmacological properties such as anticancer, antioxidant, analgesic, anti-inflammatory, aphrodisiac, hepatoprotective, and more.[1, 2] In Africa, anaemia and guinea worm illness are treated with a paste made from leaves and stems.[3] In addition,

several bioactive components such as fatty acids and sterols.[4, 5] Resume In earlier studies, phenolic compounds such as p-hydroxybenzoic acid, p-coumaric, ferulic acid, kaempferol, vanillic acid, syringic acid, caffeic acid, gallic acid, and from seed extracts.[6] Also, the seed extract was used for the synthesis of highly efficient silver nanoparticles that showed excellent antibacterial and anticancer activities.[7] The scientific knowledge established in the field of pharmacognosy up to October 2023 is data base. Kenaf is a promising cost-effective and environmentally friendly cellulose feedstock.[12]

2. History

Given evidence of domestication in the Sudan region about 4000 B.C., Kenaf probably originated in Africa beneath the Sahara.[13] Kenaf, a great source of raw material fibre for pulp, paper, and other fibre products, has been promoted after World War II in China, Russia, Thailand, South Africa, Egypt, Mexico, and Cuba.[14] Kenaf development and manufacturing in the United States began in the 1940s during World War II to provide cordage material for the war effort.[15] Kenaf was initially brought to Malaysia in the early 1970s, and it gained popularity in the late 1990s.[16]

3. Taxonomy

Mesta in India, Ambari in Taiwan, Til in North Africa, and Gambo in West Africa are other names for Hibiscus cannabinus L.[17] belongs to the Hibiscus genus, which is part of the Malvaceae family.[18] With more than 400 species divided into six main groups—Furcaria, Alyogen, Abelmoschus, Ketmia, Calyphyllia, and Azanza—the Hibiscus genus is vast. The taxonomic classification of kenaf (Hibiscus cannabinus L.) is Furcaria.[19] Every species in the Furcaria section has a multiple of 18 chromosomes, with a considerable degree of polyploidy, ranging from 2n = 36 to 2n = 180.[19, 20] It has huge spectacular, light yellow, creamy-coloured blooms that are bell-shaped and widely open.[21] The fruit, or seed capsule, is 1.3–1.9 cm in diameter, 1.9–2.5 cm long, and hairy. Each of its five segments contains 20–26 seeds.[22]

Table 1.[25]

Taxonomical Classification.

Kingdom	:	Plantae
Subkingdom	:	Viridiplatae
Infrakingdom	:	Streptophyta
Superdivision	:	Embryophata
Division	:	Tracheophyta

Subdivision	:	Spermatophytina
Class	:	Magnoliopsida
Superorder	:	Rosanae
Family	:	Malvaceae
Genus	:	Hibiscus
Species	:	Hibiscus cannabinus

4. Nutrient profile

Kenaf is most commonly utilised for its fibre, its shoot parts which are usually considered industry by-products—may be used as useful ingredients in the culinary business according to data on its nutritional content. Table 2 provides a summary of the edible kenaf sections' compositional makeup, amino acid content, and significant element content.

4.1 Imminent composition

Based on the initial composition of the different kenaf tissue pieces, the flower had a greater moisture content over the other components [Table 1]. The largest amount of fibre was found in the kenaf stem. Furthermore, compared to roselle flowers, kenaf flowers showed a greater fibre content. Kenaf is recommended as a superior substitute fibre source. The greatest levels of crude protein (30.20%) and fat (22.0%) were found in kenaf seeds, which were followed by leaves, blossoms, and stems. Oil Content of kenaf seeds has been described as a desirable substitute edible oil source because of its high unsaturated acid content (oleic, linoleic, as well as linolenic) with notable levels of tocopherols and steroids.[23] After the considerable oil extraction from kenaf seeds, significant quantities of defatted kenaf seed material (DKSM) will result in only 20% of seed oil.[24]

4.2 Amino acid composition

Flowers contained the highest concentration of essential amino acids (3.696 g/0.1 kg), followed by leaves (0.2641 g/0.1 kg), seeds (0.215 g/0.1 kg), and stems (0.185 g/0.1 kg).
The glutamic acid content of kenaf seed oil demonstrated its umami flavour.[26] The primary limiting amino acids found were cystine and methionine, both of which contain sulphur.

4.3 Significant element content

The kenaf also turned out to possess the significant element content (Table 3). Calcium was the most prevalent mineral in the leaves (0.214 g/0.1 kg), The highest quantities of magnesium (0.061 g/0.1 kg) and zinc (0.030 g/0.1 kg) were identified in the seeds, whereas potassium was the most common element in other plant parts.

5. Phytochemical composition

5.1 Phenols

Of the twelve phenols found in the kenaf, caffeic acid (leaves (0.0764 g/0.1 kg), stems (0.0513 g/0.1 kg), and flowers (0.0177 g/0.1 kg)) and p-hydroxybenzoic acid (found in seeds, 0.0955 g/0.1 kg)) are the most prevalent phenolic compounds in the various components of the kenaf. The leaves exhibited the greatest total phenolic content (TPC) at 555.90 mg/100 g, followed by the stem (0.0842 g/0.1 kg), blossoms (0.3085 g/0.1 kg), and seed (0.1627g/0.1 kg).[6] More recently, tannic acid (2.9152 g/0.1kg) and catechin hydrate (0.1435 mg/0.1kg) were discovered in kenaf leaves for the first time.[27]

Table 2
Imminient composition of kenaf

Nutritional components	Stems		Seeds		Leaves		Flowers
	KenafFR[50]	KenafDR[51]	KenafFR[50]	KenafDR[52, 53]	KenafFR[50]	KenafDR[51]	KenafFR[50]
Moisture	25.8	-	8.1	9.34	11.5	-	26.0
Crude Fat	0.6	-	22.0	0.73	4.20	-	3.5
Crude Fibre	37.4	-	10.4	57.09	13.0	-	3.4
Nitrogen Free Extract	14.8	-	23.3	-	38.6	-	21.25
Ash	5.5	3.91	5.2	6.65	6.30	8.89	6.2
Crude Protein	4.7	5.21	30.2	26.19	24.0	17.62	4.9

"-" = Unavailable,
Where R= Raw, F=Fresh, D= Dried.

Table 3
Significant element present in kenaf.

Minerals(mg/100 DW)	Seeds	Leaves		Flowers
	KenafFR[50]	KenafFR[50]	KenafFR[50]	KenafFR[50]
Calcium (Ca)	89.0	27.0	214.2	43.0
Phosphorus (P)	28.0	88.0	39.0	44.0
Potassium (k)	315.0	153.0	157.0	260.0
Magnesium (Mn)	48.0	61.0	30.0	34.0
Zinc (Zn)	16.8	30.0	16.2	24.4
Iron (Fe)	13.0	7.0	34.0	42.0

"-" = Unavailable,
Where R= Raw, F=Fresh, D= Dried.

5.2 Flavonoids

There are many flavonoids in kenaf. So far, the kenaf obtained ten distinct flavonoid compounds. Derivatives of kaempferol are important components and have a variety of

pharmacological activities, like anti-inflammatory, antioxidant, antibacterial, antidiabetic, and anticancer properties.[28] Kaempferitin is abundant in the leaves (0.1782 g/0.1 kg) and stems (0.025 g/0.1 kg), whereas myricetin glycoside (0.1425 g/0.1 kg) is abundant in the blossom. Flowers had the highest total flavonoid content (TFC) at 0.7552mg/0.1 kg, followed by leaves at 0.5637 g/0.1 kg, seeds at 0.3311 g/0.1 kg, and stems at 0.2993 g/0.1 kg).[6] In addition to myricetin glycoside, kenaf and roselle flowers are abundant in anthocyanins, a family of flavonoids. Natural pigments called anthocyanins are present in plants and give them their vivid red, blue, and purple hues. They are also utilised extensively in cosmetics, medicine, and natural food colouring.[29]

5.3 Citric acid

The kenaf leaves were found to contain both forms of citric acid derivatives, with hydroxy citric acid being shown to have an impact on reducing blood insulin levels and glucose metabolism.[30]

5.4 Fatty acid

Kenaf seeds have the greatest levels of oleic acid (27.4%), palmitic acid (20.9%), and linoleic acid (46.4%). The fatty acid profiles of crude kenaf seed oils revealed that the main acids are palmitic, linoleic, and oleic acids. The fatty acids found in kenaf seed oil extract were around 71.8–78.3% unsaturated and 21.6–28.2% saturated. Monounsaturated fatty acids (MUFA) made up 28.0–44.5% of these, whereas polyunsaturated fatty acids (PUFA) made up 28.8–50.3%.[31]

6. Toxicology

According to the rats and mice oral dose toxicity test, kenaf did not impact mortality rates, clinical symptoms, body mass index, or food consumption throughout the dosing, confirming its safety, even at doses as elevated as 1.6 g/kg for KLE and 0.500 g/10 kg for KSE and KSO (39, 49). The LD 50 value for ethanolic extract was not significantly determined in mice but showed no toxicity at a higher dose of more than 4.47 g/kg.

7. Pharmacological applications

According to the researchers, kenaf leaves have the potential to significantly boost ferric-reducing capacity, scavenge free radicals, and successfully stop the promotion of superoxide dismutase levels.[32]

Pharmacological Activity	Plants part	Vehicle	Dose
Antihyperlipidemic activity.[33]	Seed	Hexane	1 mL/ kg; 10 mL/ kg
Antimicrobial activity.[32, 35]	Leaves	Ethanol	39.06–10000 µg/ mL
	Leaves	Water	12–12000 µg/ mL
Anti-inflammation activity.[38, 39]	Leaves	90% Methanol; Water	200/ 400 mg/ kg
	Seed	Hexane; 80% Ethanol	500 mg/ kg
Anticancer activity.[40, 53, 54]	Seed	80% Ethanol. Hexane	15.63–1000 µg/ mL
	Seed	Hexane	50–300 µg/ mL
	Seed	CO^2	1–5 g/ kg
Antioxidant activity.[32, 40, 6, 55]	Leaves	Ethanol	0.5 mg/ mL
	Leaves/ Seed	Water	0.2 g/ mL
	Seed	80% Ethanol	-
	Seed	Hexane	1–10 mg/ mL
Antityrosinase activity.[32, 56]	Leaves	Ethanol	5 mg/ mL
	Leaves	Ethanol	IC50: 3.5 mg/ mL
Hepatoprotective activity.[45]	Leaves	Water	1.6 g/ kg
Antiulcer activity.[57, 58, 59]	Leaves	Methanol	1.6 g/ kg; 3.2 g/ kg
	Seed	Hexane	1000 mg/ kg
	Seed	Hexane	500 mg/ kg

7.1 Antihyperlipidemic activity

Elevated blood total cholesterol (TC), low-density lipoprotein cholesterol (LDL-C), very low-density lipoprotein cholesterol (VLDL-C), and decreased high-density lipoprotein cholesterol (HDL-C) are the hallmarks of hyperlipidaemia. An increased risk factor for the occurrence and severity of heart disease, hypertension, and arteriosclerosis is hyperlipidaemia. Furthermore, 400 mg/kg KLE has antihyperlipidemic effects similar to those of the common medication atorvastatin and can significantly reduce liver microvesicular steatosis. On the other hand, kenaf seed oil nanoemulsion (KSON) shown outstanding effectiveness in reducing liver fat, controlling weight, and decreasing cholesterol (as evidenced by decreased blood TC, TG, LDL cholesterol, atherogenic index (AI), and cardiac risk index (CRI)).[33]

7.2 Antimicrobial Activity

According to prior data, the use of traditional antibiotics made from synthetic materials is always accompanied by expensive, prolonged therapy and an increase in drug resistance.[34] Pseudomonas (5000 µg/mL)), Bacillus cereus (10000 µg/mL), Staphylococcus epidermis (10000 µg/mL), Salmonella (5000 µg/mL), Staphylococcus aureus (625 µg/mL), and Bacillus subtilis (156.25 µg/mL were shown to be effectively inhibited by the ethanolic kenaf leaves extract (KLE).[32] Furthermore, kenaf leaf aqueous extract is efficient against Escherichia coli.[35] Kenaf leaves have the potential to be utilised as a natural preservative and biocontrol agent to prolong the shelf life of food and prevent microbiological spoiling.[36]

7.3 Anti-inflammatory activity

The body's immune system's reaction to different stimuli is known as inflammation, and it involves a series of signals and responses that trigger the activation of the adaptive immune response and innate immune cells.[37] Although not comparable to the standard control, indomethacin, the KLE extracts demonstrated considerable ($p < 0.05$) dose-dependent reduction of rat paw oedema.[38] By using male Sprague Dawley rats to generate paw oedema by the application of histamine, carrageenan, and arachidonic acid, the anti-inflammatory properties of KSE and KSO are examined. Following a 5-hour injection, treatment with KSE (500 mg/kg) demonstrated histamine-induced paw oedema was inhibited by 73.18%, carrageenan-induced paw oedema by 74.72%, and arachidonic acid-induced paw oedema by 83.33%. Additionally, KSE had anti-inflammatory efficacy that was equivalent to RSE in that it caused paw oedema following a 5-hour injection of histamine (73.18%) and arachidonic (69.60%).[39]

7.4 Anti-Cancer Activity

Under an inverted light microscope, CCL-2 (HeLa), MCF-7 (breast cancer), HCT-116 (gastrointestinal cancer), and SK-LU1 (lung cancer) showed evidence of apoptosis after 72 hours of KSE and KSO treatment. These signs included cellular shrinkage, membrane blebbing, and the development of apoptotic structures.[40] The KSE exhibited a lower IC50 than kenaf seed oil in all cancer cell lines.[40] KSO reduced the severity of leukaemia in WEHI-3B cells by increasing the proliferation of cytotoxic T cells to kill the leukaemia cells, inhibiting the growth of immature monocytes and granulocytes, decreasing the weights of the liver and spleen, and reducing leukemic cells into the splenic red pulp.[41]

7.5 Antioxidant Activity

According to the researchers, kenaf leaves have the potential to significantly boost ferric-reducing capacity, scavenge free radicals, and successfully stop the promotion of superoxide dismutase levels.[6, 32] In the total antioxidant activity test, KSE showed a high retardation towards the generation of hydroperoxides and thiobarbituric acid reactive compounds, demonstrating significant radical scavenging action through β-carotene bleaching.[42] Higher DPPH radical scavenging activity was demonstrated by the KLE (73.2%) and KSE (70.4%).[6, 43]

7.6 Antityrosinase activity

Tyrosinase is likely to catalyse the natural phenolic compounds since they have a chemical structure with L-3,4-dihydroxyphenylalanine (L-DOPA) and can act as competing inhibitors. As a result, plant extracts containing phenolic compounds generally exhibit a positive relationship with the tyrosinase inhibitory action.[44] Using L-tyrosinase as the substrate, the KLE was shown to have antityrosinase activity (77.50%).[32] By preventing L-tyrosinase from oxidising to L-DOPA during melanogenesis and enzymatic browning, KLE functions as an efficient tyrosinase inhibitor.[44]

7.7 Hepatoprotective activity

Changes in the liver's regular activities, which include regulating metabolism, secretion, storage, and detoxification, are frequently linked to hepatic injury. The water-soluble extract from kenaf leaves at a concentration of 1600 mg/g has been reported to shield the liver against oxidative damage brought on by paracetamol (PCM) and carbon tetrachloride (CCl4). Rats with liver damage showed a substantial reduction in bilirubin, lipid peroxidation, alanine aminotransferase (ALT), and aspartate aminotransferase (AST) levels in their plasma following the initial KLE therapy.[45] The hepatoprotective effect of kenaf leaves may be due to the cytochrome P450 enzyme inhibitor action, glucoronidation activity augmentation, and natural antioxidant compounds in KLE that may neutralise the CCl* and N-acetyl-p-benzoquinone-imine electrophilic metabolite.[46]

7.8 Anti-Ulcer activity

Gastric ulcers are believed to be caused by an imbalance between luminal acid production and mucosal defence. The aggressive factors are composed of pepsin and acid, whereas the defensive factors are composed of prostaglandins, the mucous layer of mucin–bicarbonate secretion, and other healing factors. The histological analysis also showed that KLE may

shield the mucosal layer from inflammation and ulcers, with an 82% protection index at 3.2 g/kg when compared to control. Furthermore, the extracts' concentration of free and total acidity was considerably reduced, indicating that KLE had an antisecretory action.[47] KSO demonstrated a higher proportion of protection against cold-restrain stress-induced ulcers, ethanol, and non-steroidal anti-inflammatory medications (NSAIDs).[48]

8. CONCLUSION

The nutritional composition, phytochemical study, pharmacology, and possible uses of kenaf were compiled in this review based on both contemporary and traditional research. There is currently insufficient health-related understanding about kenaf, and its potential for clinical use has not been thoroughly investigated. Consequently, more excellent study on both humans and animals should be conducted to examine the active ingredient in kenaf that gives it its pharmacological qualities, particularly its mode of action. Given its wide range of bioactive components and possible benefits, kenaf is an edible plant resource that is generally beneficial and deserving of more research. The novel products that include kenaf extracts should also have their sensory and nutritional qualities assessed.

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