

Review of *Catha edulis* in Kenya: Varieties, Phytochemistry and Pharmacology

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Catha edulis (Vahl) Endl. (Celastraceae family), commonly referred to as “khat”, is a plant native to East Africa and the Arabian Peninsula. The plant is consumed for its stimulant effects and has thus gained great commercial importance both locally and internationally. In Kenya, there are two main varieties of *Catha edulis*; *miraa* and *muguka*. Although *muguka* is relatively cheaper than *miraa*, it is the most potent variety. Consumption of *Catha edulis* is associated with several detrimental health effects. Although the consumption of *khat* in Kenya is not prohibited, the active constituent, cathinone, is a controlled drug due to potential of abuse and addiction. The debate around controlling the sale of *miraa* and *muguka* in Kenya continues with the recent ban on supply of *muguka* in Mombasa and Kilifi counties in 2024 which sparked mixed reactions from various stakeholders. This review focuses on varieties, phytochemical composition and pharmacological effects of *Catha edulis* in Kenya.

Key words: *Catha edulis*, varieties, *miraa*, *muguka*

INTRODUCTION

There is perpetual global debate on the production and use of *Catha edulis* based on its potential adverse effects as well as commercial value. Some countries totally prohibit the cultivation and use of the plant whereas others are permissive about it. In Kenya, cultivation and supply of *Catha edulis* is legal despite some discourse around the social impact and commercial value of the plant. Nonetheless, *Catha edulis* is a major cash crop contributing to livelihood of many families as well as a revenue stream to government through taxation and export trade. Conversely, there is cause for its restriction due to the social concerns such as massive school drop outs in the Khat farming areas as well as health concerns among those who consume it.

Catha edulis (Vahl) Endl. (Celastraceae family) is an evergreen shrub or tree that grows up to 25 meters tall. The young leaves and stems are chewed for the amphetamine-like stimulant effect. The plant is native to tropical Africa (East, Central and Southern Africa) but has also been introduced to Somalia, Yemen and Hawaii. Wild Khat is endemic to East Africa and Arabian Peninsula but possesses low

economic value due to low potency as it contains low amounts of cathinone. Khat is mainly cultivated in Kenya, Ethiopia, Yemen and Somalia with a distribution profile as depicted in Figure 1.

Catha edulis is known by different names in the regions where it is found. In Kenya, the plant is commonly known as *miraa*. Other names include *mairungi* (Uganda), *qaad* (Somalia), *khat* (Ethiopia), *qat* (Yemen), and *muhulo* (Tanzania).¹ *Catha edulis* forms an important part of the social and cultural heritage in these regions.

Catha edulis varieties in Kenya

Historical evidence suggests the existence of *Catha edulis* since early 13th century in the Southwestern Arabian region and Ethiopia, which later spread to Yemen in the 15th century.² It is postulated that *miraa* was discovered by the Ameru farmers and gatherers in Egypt. The community carried it along their migration itinerary into present day Kenya. The plant was critical in their survival during the long journey as it suppressed hunger and thirst. During their exodus, some seedlings were left in Ethiopia and later passed to Djibouti and Arabic countries.³

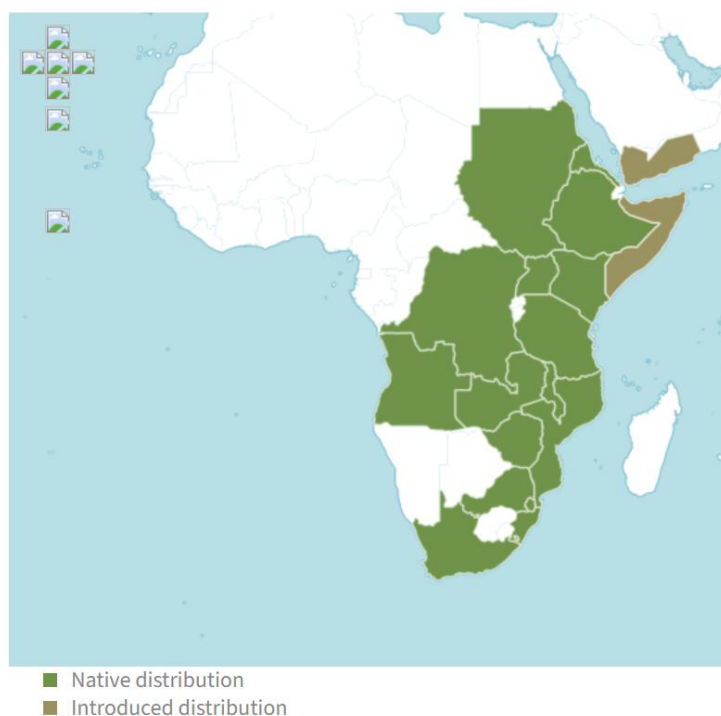


Figure 1: Distribution of *Catha edulis* in Africa and Arabia.

Adapted from: [Catha edulis \(Vahl\) Endl. \(worldfloraonline.org\)](http://worldfloraonline.org)

In a phylogeographic study across the historical *Catha edulis* cultivation areas to identify origin of the species and their genetic divergence, two centres of origin for cultivated *miraa* were identified; one in Kenya and another from Ethiopia. The cultivated *Qat* in Yemen seems to have originated from Ethiopia since they have similar genotypes. However, the wild *Catha edulis* in Yemen differs from the cultivated type. On the other hand, in Kenya, only a small portion of cultivated *Catha edulis* is derived from the Ethiopian genotype. The majority of *Catha edulis* in the main cultivation regions in Kenya is derived from the wild Kenyan type which was not found anywhere else in the world. In Northern Kenya, there exists a hybrid comprising of the Kenyan and Ethiopian types.⁴ Therefore, *Catha edulis* genotypes present in Kenya are unique and differs from those grown anywhere else in the world. For a long time, Kenyan *khat* enjoyed popularity in the international market due to its higher cathinone levels compared to other varieties. However, the ban in United Kingdom in the year 2014 saw a drastic decline in this popularity.⁵

In Kenya, *Catha edulis* is mainly found in the counties of Meru and Embu. More than 10

different traditional varieties have been identified in these regions based on their morphological features, taste and stimulant intensity. The varieties identified from Meru County include; *kigwe*, *kilantune*, *kiraa kikiiru (Asili)*, *kithaara*, and *muchuri*. *Kiraa gikiiru* variety is highly reputable and considered as the native type. It has a sweet taste and produces softer twigs whilst also claimed to have no negative physiological effects. *Kigwe*, the second common variety in this region, is very potent but is also associated with undesirable effects. On the other hand, the Embu varieties include; *gitu*, *kibwe*, *muguka*, *mugumo*, *mugwathingi*, and *muti- mutiri*. Among these, *muguka* is considered the most potent and is the most preferred by members of this community.⁶ However, this classification is not based on genotypes but rather on traditional methods by experienced members of the community.

In a study to identify genetic variability of the *Catha edulis* cultivars in Kenya, 30 samples of cultivars from Embu and Meru counties were classified into 3 major clusters as shown in table 1.

Table 1: Genetic diversity of different *Catha edulis* cultivars from Embu and Meru counties

Cluster	Sub-cluster	Cultivars
A		<i>Gitu, Kira kiiru-2</i>
B	1	<i>Kiithaara and Kira gitune-2</i>
	2	<i>Mugiza-1, Mukurukuru and Mugumo-3</i>
C		<i>Mugumo-(1,2, 4,5), Mugiza-2, Muguka-(1,2,3,4,5), Mutimutiri, Kira kiiru-2, Muguka wa karimi, Muchuri, Muruti, Mutamucii, Gitune-1, Mumbu, Muceke</i>

The highest levels of similarity were observed for *Kira-gitune, mugiza -1, mugumo -3, kithaara, kiira kiiru, kiira kieru* and *mukurukuru* varieties. On the other hand, most differences were observed among *kira-kieru, muchuri, muguka 1 & 2, muguka wakarimi, mugumo, mutimutiri and mugiza-2*. It was noted that the *muguka* varieties were distinctly different from all the other varieties with 100 % dissimilarity. Furthermore, the different *muguka* varieties were also found to be different from each other. These variations could be attributed to factors such as interaction with environment, mutations and genetic drift among others. The variations could be responsible for the morphological differences as well as amount of the psychoactive components in *C. edulis*.⁷ However, in this

study, the levels of the psycho-active components were not determined for the different cultivars.

For commercial purposes, *Catha edulis* in Kenya is broadly classified into 2 types: *miraa* and *muguka*. According to this categorization, *muguka* refers to the short shrub with edible leaves that is predominantly grown in Embu County whereas *miraa* is a tall tree that produces succulent stems that are chewed and mostly cultivated in Meru County as shown in Figure 2. The leaves are the main morphological sources of cathinone, the active component of *Khat*. Given that *muguka* has higher leaf density per square meter, it has higher concentration of cathinone compared to *miraa*.⁸

*Miraa**Muguka***Figure 2: Photographs of *miraa* and *muguka* plants. (Photo by NAM, February 2026)**

PHYTOCONSTITUENTS

Catha edulis contains various phyto-constituents such as flavonoids, glycosides, alkaloids, sterols, terpenoids, tannins, amino acids, vitamins and minerals. Among them, the phenylalkylamines alkaloids, are responsible

for its stimulant effects. They include cathinone, cathine (norpseudoephedrine), norephedrine, merucathinone, merucathine and pseudomerucathine. Cathinone, the main psycho-active compound, is similar to amphetamine. The chemical structures of these compounds are illustrated in Figure 3.

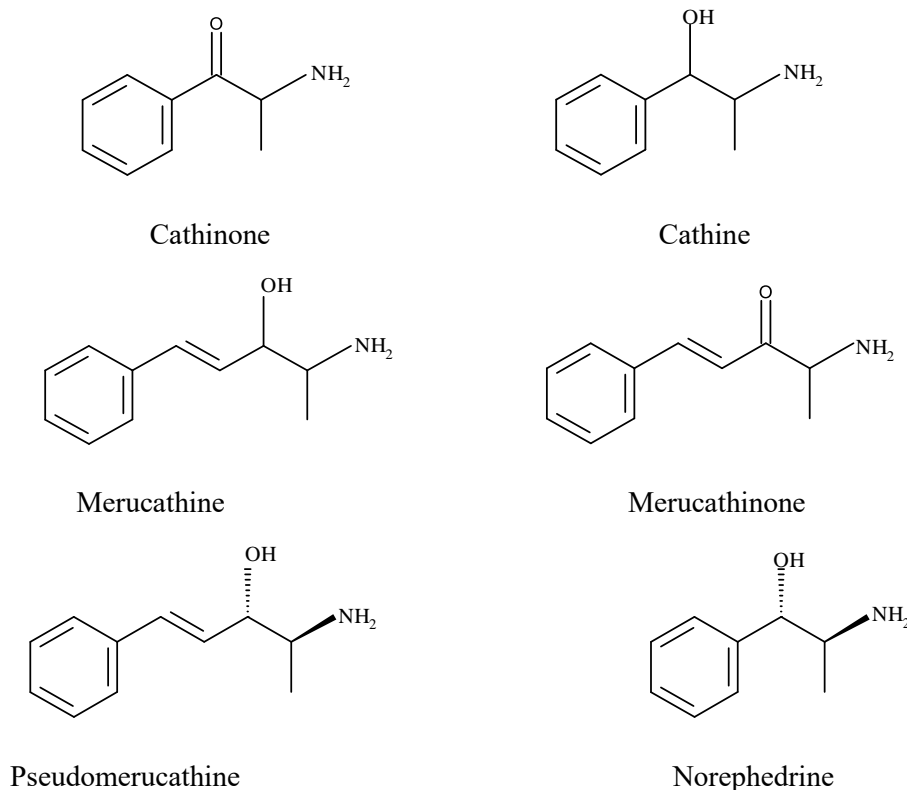


Figure 3: Chemical Structures of main active components of *Catha edulis*

The concentration of cathinone within the plant varies between 78-343 mg per 100 g of leaves. The amount is highest in fresh leaves but decomposes to inactive dimer (3,6-dimethyl-2,5-diphenylpyrazine), cathine and norephedrine when exposed to sunlight, heat, upon storage or extraction processes. This explains why *C. edulis* is often wrapped in banana leaves to prevent the degradation. Mature leaves have less cathinone but more cathine and norephedrine which are less active.^{9,10}

PHARMACOLOGY AND ADVERSE EFFECTS

Upon chewing, 90 % of cathinone is released from *C. edulis* and rapidly absorbed through the oral mucosa to the systemic circulation. Only a

small amount is absorbed through the gastrointestinal tract after the juice is swallowed. Due to its high lipid solubility, cathinone crosses the blood-brain barrier and enters the central nervous system to produce the stimulant effects. Cathinone is metabolized to cathine which has about 10 % of the stimulant effect of amphetamine.

Within the central nervous system, cathinone acts by stimulating the release of serotonin and dopamine and inhibiting their reuptake. It also binds to serotonin and dopamine receptors to elicit stimulatory effects which include; increased alertness, euphoria and aggressive behavior. These effects are seen within 30 minutes of consumption of the plant material. Long term use could result into tolerance,

dependence, cognitive impairment and psychiatric symptoms.^{9,11}

Cathinone has the highest affinity for noradrenaline receptors which results to the peripheral nervous system symptoms associated with the use of *C. edulis*. The

cardiovascular system is mostly affected resulting into increase blood pressure, tachycardia, acute myocardial infarction, coronary vasoconstriction, risk of stroke and even death. Many other body systems are adversely affected by the use of *Catha edulis* as illustrated in Table 2.

Table 2: Adverse effects of *Catha edulis* on various body systems

Body system	Effects	References
Cardiovascular	Vasoconstriction, palpitations, tachycardia, arrhythmias, hypertension, myocardial infarction, myocyte hypertrophy, cerebral hemorrhage, pulmonary edema, stroke	2,12
Nervous/ Behavioral	Headache, dizziness, tremors, irritability, impaired cognitive function, depression, anorexia, insomnia, hallucinations, psychosis, memory loss	10,11
Gastro-intestinal	Xerostomia, dental caries, periodontal disease, tooth loss, mucosal pigmentation, stomatitis, polydipsia, gastritis, paralytic ileus, constipation, duodenal ulcers, constipation, weight loss, hemorrhoids, malignancies	9,13
Hepato-biliary	Cirrhosis, fibrosis, hepatitis	9
Respiratory	Tachypnea, bronchitis, decreased lung function	9,14
Genito-urinary and obstetric effects	Urine retention, spermatorrhea, deformed spermatozoa, impotence, changes in libido, low birth weight, teratogenic, still births, impaired lactation,	15
Ocular effects	Mydriasis, blurred vision	9
Endocrine and Metabolic effects	Hyperthermia, perspiration, hyperglycemia,	9

The foregoing illustrates the disastrous effects of *Catha edulis* on the human body systems. There has been heated debate over recent years whether miraa should be banned or encouraged in Kenya. Those who support the cultivation of khat argue that it is an important crop that supports the economy not just for the local communities but also for the nation as a source of foreign exchange. *Miraa* farming creates employment to thousands of Kenyans including farmers, transporters and the traders. It is the main source of income to the communities where it is cultivated. Therefore, a total ban on its cultivation would adversely affect these communities unless alternative sources of income are sought. In addition, the cultural significance of this plant cannot be overlooked. Chewing *miraa* is associated with cultural

practices such as peace negotiations and other community ceremonies as a symbol of friendship and respect. This is considered important heritage in these communities. There is need to preserve such heritage for future generations.

On the other hand, the opponents of *miraa* farming base their argument on the disastrous health effects and the negative social effects within communities where it is cultivated. The consumption of *khat* is associated with family neglect, breakdown of families, school drop-outs, and general laziness.

Although the cultivation of this plant brings undeniable economic benefits to many Kenyan communities, these health and social impacts cannot be overlooked. This calls for proper

stakeholders' engagement to achieve a balanced approach that promotes responsible consumption, rethink alternative income generating activities to ensure the gains don't come at the expense of the well-being of the population.

CONCLUSION

The Kenyan *Catha edulis* is different and more potent than other types found in other regions of the world. There exist two main varieties in Kenya: *miraa* and *muguka* based on the

genotypes. *Muguka*, the short shrub with edible leaves and mainly grown in Embu County, is the most potent type whereas *miraa* is a tree with succulent stems found in Meru. However, more studies are required to quantify the amount of cathinone in the different varieties of *Catha edulis* in Kenya. While the cultivation of *Catha edulis* boosts the county's economy, the social and health benefits can no longer be overlooked. Therefore, a balanced approach is needed to ensure the benefits of *Catha edulis* do not outweigh the well-being of the society.

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