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Review Article
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AN OVERVIEW ON OKRA (*ABELMOSCHUS ESCULENTUS*) AND IT'S IMPORTANCE AS A NUTRITIVE VEGETABLE IN THE WORLD

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ABSTRACT

Okra a commercial vegetable crop belongs to family Malvaceae. It originates from Ethiopia and is widely spread all over tropical, subtropical and warm temperate regions of the world. It plays an important role in the human diet and is a good source of protein, carbohydrates, vitamins, calcium, potassium, enzymes, and total minerals which are often lacking in the diet of developing country. Its medicinal value has also been reported in curing ulcers and relief from hemorrhoids. Okra has found medical application as a plasma replacement or blood volume expander and also useful in genito-urinary disorders, spermatorrhoea and chronic dysentery. The fruits of okra have reawakened beneficial interest in bringing this crop into commercial production.

KEY WORDS

Abelmoschus esculentus, Biochemical composition, diseases, insects, okra, origin, production.

INTRODUCTION

Okra (*Abelmoschus esculentus* (L.) Moench) known in many English-speaking countries as lady's fingers, bhindi in India, krajiab kheaw in Thailand, okra plant, ochro, okoro, quimgombo, quingumbo, gombo, kopi arab, kacang bendi and bhindi in South East Asia. However, in Middle East it is known asbamia, bamya or bamieh and gumbo in Southern [1]. Portuguese and Angola, okra is known as quiabo, and as quimbombo in Cuba, gombo commun, gombo, gumbo in France, mbamia and mbinda in Sweden, and in Japan as okura [2], [3]. Taiwan is called qiu kui [4] Nigeria spoken in Igbo [5]. It belongs to family malvaceae and genus *Abelmoschus* .The geographical origin of okra is disputed, with supporters of South Asian, Ethiopian and West African origins. The plant is cultivated in tropical, subtropical and warm temperate regions around the world [6]. Okra can be grown on wide range of soils, but well drained fertile soils with adequate organic matter result to high yield [7]. The crop is widely cultivated throughout the year in the tropics. Okra is a nutritious vegetable which plays important role to meet the demand of vegetable are scanty in the market [8]. In 2009-2010, the total world area under cultivation was 0.43 million hectares and the production stood at 4.54 million tons and India production of okra 5784 thousand tones and productivity 11.1 tones/hectare [9]. The yield is very low as compared to the yield 9.7-10 tones ha^{-1} of other developing countries of the

world [10]. India being largest producer (67.1%), followed by Nigeria (15.4%) and Sudan (9.3 %) [11].

GEOGRAPHIC ORIGIN AND DISTRIBUTION OF OKRA

Okra plant or lady' finger was previously included in the genus *Hibiscus,* section *Abelmoschus* in the family Malvaceae[12]. The section *Abelmoschus* was subsequently proposed to be raised to the rank of distinct genus [13]. The wider use of *Abelmoschus* was subsequently accepted in the taxonomic and contemporary literature [14]. The genus *Hibiscus* by the characteristics of the calyx, spathulate, with five short teeth, connate to the corolla and caducous after flowering [15, 16]. Okra originated somewhere around the Ethiopia, and was cultivated by the ancient Egyptians by the 12th century B.C. Its cultivation spread throughout Middle East and North Africa [3, 17]. The taxonomical revision undertaken by Borssum and co-workers [18] and its continuation by Bates [19] constitutes the most fully documented studies of the genus *Abelmoschus*. Taking classification of van Borssum Waalkes as the starting point, an up-to-date classification was adopted at the International Okra Workshop held at National Bureau of Plant Genetic Resources (NBPGR) in 1990. Although about 50 species have been described, eight are most widely accepted [20]. Okra is grown in many parts of the world, especially in tropical and sub-tropical countries [21, 22]. This crop can be grown on a large commercial farm or as a garden crop [23]. Okra plants are grown commercially in many countries such as India, Japan, Turkey, Iran, Western Africa, Yugoslavia, Bangladesh, Afghanistan, Pakistan, Myanmar, Malaysia, Thailand, India, Brazil, Ethiopia, Cyprus and in the Southern United States [24, 25, 26].

STRUCTURE AND PHYSIOLOGY

Abelmoschus esculentus is cultivated throughout the tropical and warm temperate regions of the world for its fibrous fruits or pods containing round, white seeds. It is among the most heat and drought tolerant vegetable species in the world and will tolerate soils with heavy clay and intermittent moisture but frost can damage the pods. In cultivation, the seeds are soaked overnight prior to planting to a depth of 1-2 cm. Germination occurs between six days (soaked seeds) and three weeks. Seedlings require ample water. The seed pods rapidly become fibrous and woody, and to be edible, must be harvested within a week of the fruit having been pollinated. The fruits are harvested when immature and eaten as a vegetable [27].

CYTOGENETIC RELATIONSHIP

There are significant variations in the chromosome numbers and ploidy levels of different sepceis in the genus *Abelmoschus.* The lowest number reported is 2n=56 for *A. angulosus* [28], whereas the highest chromosome number reported are close to 200 for *A. manihot var. caillei* [29, 30, 31]. The chromosome number within *A. esculentus*, s 2*n* = 72, 108, 120, 132 and 144 are in regular series of polyploids with *n* = 12 [32].

BIOCHEMICAL COMPOSITION OF OKRA

The composition of okra pods per 100 g edible portion is water 88.6 g, energy 144.00 kJ (36 kcal), protein 2.10 g, carbohydrate 8.20 g, fat 0.20 g, fibre 1.70 g, Ca 84.00 mg, P 90.00 mg, Fe 1.20 mg, β-carotene 185.00 µg, riboflavin 0.08mg, thiamin 0.04 mg, niacin 0.60 mg, ascorbic acid 47.00 mg. Protein, carbohydrate and vitamin C contains of okra [3, 22, 33, 34, 35] and plays a vital role in human diet [22, 36]. Consumption of young immature okra pods is important as fresh fruits, and it can be consumed in different forms [1]. Okra fruit is principally consumed fresh or cooked and is a major source of vitamins A, B, C, minerals, Iron and Iodine and important vegetable source of viscous fiber but it is reportedly low in sodium saturated fat and cholesterol [37, 38, 39]. Presence of Fe, Zn, Mn and Ni also has been reported [40]. Okra provides an important source of vitamins, calcium, potassium [41] and other mineral matters which are often lacking in the diet in developing countries [20]. Seven days old fresh okra pods have the highest concentration of nutrients [42].

The composition of okra leaves per 100 g edible portion is: water 81.50 g, energy 235.00 kJ (56.00kcal), protein 4.40 g, fat 0.60 g,

carbohydrate11.30 g, fibre 2.10 g, Ca 532.00 mg, P 70.00 mg, Fe 0.70 mg, ascorbic acid 59.00 mg, β-carotene 385.00 µg, thiamin 0.25 mg, riboflavin 2.80 mg, niacin 0.20 mg [34],[11]. Carbohydrates are mainly present in the form of mucilage [43], [44]. The leaf buds and Flowers are also edible [45].

Okra seeds contain about 20% proteins and 20% oil [17], [46]. Okra seed oil has potential hypo-cholesterolemic effect [47]. The potential for wide cultivation of okra for edible oil as well as for cake is very high [48]. Okra seed flour could also be used to fortify cereal flour [49]. For example, supplementing maize ogi with okra meal increases protein, ash, oil and fiber content) [50]. Okra seed flour has been used to supplement corn flour for a very long time in countries like Egypt to make better quality dough [51]. Its ripe seeds are roasted, ground and used as a substitute for coffee in some countries [52]. Mature fruits and stems containing crude fibre are used in the paper industry Greenish-yellow edible okra oil is pressed from okra seeds; it has a pleasant taste and odor, and is high in unsaturated fats such as oleic acid and linoleic acid [53]. The oil content of some varieties of the seed can be quite high, about 40%. Oil yields from okra crops are also high. A 2009 study found okra oil suitable for use as a biofuel [54]. The roots and stems of okra are used for clarification of sugarcane juice from which gur or brown sugar is prepared [2].

INSECT PEST ON OKRA PLANT

Incidence of insect pests is one of the prime factors in production of okra. The crop is attacked by several insect pests among which shoot and fruit borer, *Earias vittella* (Fabricius) and *Earias Insulana* are most serious as it take upper hand by causing direct damage to tender fruits. 88 to 100 percent damage to fruits by fruit borer [55]. The normal seeds per fruit were reduced by 16.47 per cent with increase in stained seeds by 200 per cent and damaged seeds by 18.70 percent infested okra fruits when compared with healthy [56]. The incidence of fruits borers' usually occurring humid condition after the rainfall. The adults' female lays eggs individually on leaves, floral buds on tender fruits. Small brown caterpillars bore into the top shoot and feeds inside the shoot before fruits formation. Later on, developed and bore into the fruits and feed within the fruits. Affected fruits become unfit for consumption purposes.

Leafhopper, *Amrasca biguttula biguttula* (Ishida) and shoot and fruit borer, *Earias* spp. is a major concern and cause havoc damage. Leafhopper alone had caused 32.06%–40.84% [57]. Shoot and fruit borer caused 50% reduction in fruit yield [58]. Larvae of fruit and shoot borer bore into shoots during the vegetative growth stage and later in flowers and fruits, rendering fruit unfit for human consumption. Various strategies recommended controlling the pests, the use of insecticide has resulted immediate relief to crop and apparently benefited formers. For same reason the use of chemical is increasing rapidly and will continue in days to come until some reliable alternative control measures are developed. 95% populations of Asian countries are used insecticides.

DISEASES OF OKRA PLANT

The okra plant has the following diseases associated with it.

Yellow Vein Mosaic Virus (YVMV)

Causative agent: Yellow Vein Mosaic Virus This is the most important and destructive viral disease in okra that infects crops at all the stages growth. The fruits of the infected plants become pale yellow to white in color, deformed, small and tough in texture. The disease causes 50-100% loss in yield and quality if the plants get infected within 20 days after germination [59], [60], [61].

Cercospora Leaf Spot

Causative agent *Cercospora abelmoschi, C. malayensis, C. hibisci* In India, three species of *Cercospora* produce leaf spots in okra C. *malayensis* causes brown, irregular spots and C. *abelmoschi* causes sooty black, angular spots .The affected leaves roll, wilt and fall. The leaf spots cause severe defoliation and are common during humid seasons [46] [52]

Fusarium Wilt

Causative agent: *Fusarium oxysporum f. sp. Vasinfectum* Fursarium wilt, a serious disease, found wherever okra is grown intensively. The fungus invades the roots, colonizes the vascular system and

thereby restrict water translocation. The disease is soil borne and spread through interculture operation.

Powdery Mildew

Causative agent: *Erysiphe cichoracearum, Sphaerotheca fuliginea*, Powdery mildew is caused by *Erysiphe cichoracearum* and *Sphaerotheca fuliginea.* The disease caused by the former is most common in okra growing areas where as the latter has been reported from Bangalore lately [62].

Damping Off

Causative agent *Pythium* spp., *Rhizoctonia* spp. Damping off disease may kill seedlings before or soon after they emerge. Infection before seedling emergence results in poor germination due to decay of seeds in soil. Cool, cloudy weather, high humidity, wet soils, compacted soil, and overcrowding especially favour development of damping-off [63].

Enation Leaf Curl

The natural transmission of the disease agent occurs through whitefly. The important symptoms of this disease are curling of leaves in an adaxial direction, and mild or bold enations on the under surface of the leaves (become thick and deformed). The plant growth is retarded. Fruits from infected plants are small and deformed and unfit for marketing [64].

Root-Decaying Disease

This disease results in the death of the young seedlings. They are more prevalent when the crop is planted in cold, wet soil [62].

USES OF OKRA IN SEVERAL COUNTRIES

In Iran, Egypt, Lebanon, Israel, Jordan, Iraq, Greece, Turkey and other parts of the eastern Mediterranean, okra is widely used in a thick stew made with vegetables and meat. In Indian cooking, it is sautéed or added to gravy-based preparations and is very popular in South India. It became a popular vegetable in Japanese cuisine towards the end of the 20th century, served with soy sauce and katsuobushi or as tempura. It is used as a thickening agent in Charleston gumbo. Breaded, deep fried okra is served in the southern United States. The immature pods may also be pickled. Okra leaves may be cooked in a similar manner as the greens of beets or dandelions. The leaves are also eaten raw in salads. Okra leaves may be cooked in a similar way to the greens of beets or dandelions. Since the entire plant is edible, the leaves are also eaten raw in salads. Okra seeds may be roasted and ground to form a caffeine-free substitute for coffee [52]. When importation of coffee was disrupted by the American Civil War in 1861, the *Austin State Gazette* said "An acre of okra will produce seed enough to furnish a plantation of fifty negroes with coffee in every way equal to that imported from Rio.

MEDICINAL PROPERTY OF OKRA

It is medicinal value has also been reported in curing ulcers and relief from hemorrhoids [65]. Unspecified parts of the plant were reported in 1898 to possess diuretic properties [66] this is referenced in numerous sources associated with herbal and traditional medicine. Okra has found medical application as a plasma replacement or blood volume expander [67] [68], [69], [70], [62]. It is also good source of iodine which is useful in the treatment of simple goiter and source of other medically useful compound [37]. It is very useful genitourinary disorders, spermatorrhoea and chronic dysentery [71]. Tests conducted in China suggest that an alcohol extract of okra leaves can eliminate oxygen free radicals, alleviate renal tubular-interstitial diseases, reduce protein urea, and improve renal function [43], [44]. Unspecified parts of the plant were reported in 1898 to possess diuretic properties [66] this is referenced in numerous sources associated with herbal and traditional medicine. Some studies are being developed targeting okra extract as remedy to manage diabetes.

CONCLUSION

Okra (*Abelmoschus esculentus* (L.) Moench) is a medicinal plant of immense importance with large pharmacological applications. Besides having the above mentioned nutritional and medical, industrial properties, it has been used as an ingredient of many herbal formulations, which are used for the cure of various ailments, in particular the regulation of blood pressure, fat, diabetes, chronic dysentery genito-urinary disorders, simple goiter and ulcer.

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