Bioprospecting potential of *Abelmoschus esculentus* for Access and Benefit Sharing

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1. Introduction

Ethiopia is lucky to be gifted with rich biodiversity and traditional knowledge that could pioneer successful bioprospecting. However, like any other developing countries, Ethiopia lacks technical expertise and monetary resources to explore them significantly. The only option for Ethiopia is to collaborate with the developed nations or domestic investors and interested pharmaceutical, cosmetics and other companies alike and jointly explore them strategically and wisely. In doing so, the model of cooperation should be such that it builds the science infrastructure within, preserve and protect the local traditional medicinal and other knowledge reducing the brain drain, and equally share the outcome of the joint projects.

The Ethiopian Biodiversity Institute (EBI) is the nationwide capable authority through ABS directorate playing the practical role of the Nagoya protocol on Access and Benefit sharing of genetic resources and associated traditional knowledge. Ethiopia has the officially permitted outline for the implementation of the ABS. The laws concerning the national Access and Benefit Sharing framework is proclamation on Access to genetic Resources and Community Knowledge and Community Rights (Proclamation No 482/2006 and Regulation 169/2009). Based on these frameworks, the country has been implementing the access and benefit sharing objective of the CBD. The Proclamation includes a range of issues such as ownership, user rights, and conditions for access, benefit sharing, types of benefits, powers and responsibilities among the others.

Therefore, the objective of this information is to encourage any bioprospecting company or an individual interested to work on the genetic resource, *Abelmoschus esculentus,* for medicinal use, and industrial uses for food, flavoring and preservative.

2. The Plant

Abelmoschus esculentus (L.) Moench (Synonym *Hibiscus esculentus* L.) (Malvaceae). It is known by the common names in Amharic: ‘Bamya’, ‘Bamiya’, ‘Bameeya’. The common English names for the plant are: Okra and Lady`s fingers. The cultivated okra, ‘Lady’s finger’/‘Gumbo’, is the only vegetable crop of significance in the *Malvaceae* family (Abeykoon *et al*., 2010).

Abelmoschus esculentus is an erect, coarse annual herb of up to 2 m in height with branches of 0.6 to 1.5 meters in length and having a long-petioled orbicular-ovate shaped leaves. The lengths of its petioles are equal to the blade. It has an axillary and solitary flower with a corolla that is large and yellow to the inside and with a base that is deep purple in color. It has an elongated fruit that is 10 to 25 centimeters in length and with a diameter of 1.5 to 3 centimeters. It has a blunt point and tapering which contains rounded rows that have a kidney shaped seeds. The fruit of this particular plant gives nutrients such as protein, niacin, riboflavin, phosphorus, zinc, copper, potassium, vitamins A, B_6, C and K, thiamine, magnesium, foliate, calcium, and manganese (Ray *et al.*, 2013).

Okra is now cultivated throughout the tropical and warm temperate regions of the world for its fibrous fruits or pods containing round, white seeds. The fruits are harvested when immature and eaten as vegetable and are often cooked in day to day meals. It is highly regarded both as healthy food and medicine in the Sudan. It is available in the main vegetable market in Addis Ababa. Generally, Okra is stir-fried with spices and some sugar. In traditional medicine a table spoonful of the dried powder of the fruit steeped in glass of warm water gives thick mucilage which is useful for acute inflammation and irritation of the stomach, bowels, and kidneys. Okra is rich in minerals (calcium, phosphorus, potassium, magnesium and iron) and Vitamin C (Adetuyi *et al*., 2011).

2.1. Distribution

Okra (*Abelmoschus esculentus* L.), which originated in Asia and Africa, is one of the most important warm season fruit vegetables grown throughout the tropics. It is recognized as one of the world's oldest cultivated crops and is widely distributed from Africa to Asia, southern Europe and America. It is a popular vegetable in Sri Lanka, ranked fourth in cultivated extent among the low country vegetables (Abeykoon *et al.*, 2010). The crop is a native of Africa and is still found growing wild around River Nile as well as Ethiopia (Torkpo *et al.*, 2006). Though it ranks number one in its consumption in India, its original home is the Ethiopian Highland and Sudan, the north-eastern African countries (Kumar *et al.*, 2013). 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 (Habtamu Fekadu *et al.*, 2014).

2.2. Cultivation and yield

Okra (*Abelmoschus esculentus* (L.) Moench) is an economically important, tall growing, warm season, vegetable crop grown in tropical parts of the world. It is cultivated throughout the tropical and warm temperate regions of the world for its green edible fibrous fruits and pods containing round, white seeds as well as for its ornamental value. Okra is a tender plant and grows well in hot weather. This crop is suitable for cultivation as a garden crop as well as large commercial farm (Amadi *et al.,* 2014).

It is one of the oldest cultivated crops and presently grown in many countries. It is a tropical to subtropical crop and is sensitive to frost, low temperature, water logging and drought conditions. The cultivation from different countries has certain adaptive distinguishing characteristics specific to the country to which they belong (Kumar *et al.,* 2013).

Application of organic manure and sowing date had a significant effect on plant height, number of leaves, number of branches and number of pods. According to the results obtained from Ali *et al*. (2014), okra responded well to the application of poultry manure. Applying poultry and sowing okra first week of June of every year is recommended as good for greater pod yield production of okra.

A vegetable yield of 10 ton/ha can be considered a good harvest, but yields of over 40 ton/ha can be realized under optimal conditions. Yields are usually low (2–4 ton/ha) as a result of non-intensive growing methods. Seed yields are in the range of 500–1000 kg/ha (Kumar *et al.,* 2013).

2.4. Ethno-medicinal uses

Parts of the plants are known to have ethno-medicinal properties like antioxidant, antispasmodic, demulcent, diaphoretic, diuretic, emollient, and stimulant (Chaudhari *et al.*, 2011). It is a good vegetable for those feeling weak, exhausted, and suffering from depression and it is also used in treating ulcers, lung inflammation, sore throat as well as irritable bowel. Okra is good for asthma patients and it also normalizes/stabilizes blood sugar and cholesterol levels (Subrahmanyam *et al.*, 2011). Okra polysaccharide possesses anti complementary and hypoglycemic activity in

normal mice. It also lowers cholesterol level in blood and may prevent cancer by its ability to bind bile acids (Ray *et al*., 2013). Additionally, Okra seed possess blood glucose normalization and lipid profiles lowering action in diabetic condition. In some countries, okra also is used in folk medicine as antiulcerogenic, gastroprotective and diuretic agents (Doreddula *et al*., 2014).

Okra is also a popular healthy food due to its high fiber, vitamin C, and foliate content. Okra is also a good source of calcium and potassium. Okra pod contains thick slimy polysaccharides, which are used to thicken soups and stews, as an egg white substitute, and as a fat substitute in chocolate bar cookies and in chocolate frozen dairy dessert (Adetuyi *et al*., 2011).

Okra (*Abelmoschus esculentus* (L.) used as antispasmodic; demulcent; diaphoretic; diuretic; emollient; stimulant and vulnerary. The roots are very rich in mucilage, having a strongly demulcent action. This mucilage can be used as a plasma replacement. An infusion of the roots is used in the treatment of syphilis. The juice of the roots is used externally to treat cuts, wounds and boils. The leaves furnish an emollient poultice. A decoction of the immature capsules is demulcent, diuretic and emollient. It is used in the treatment of catarrhal infections, dysuria and gonorrhoea. The seeds are antispasmodic, cordial and stimulant. An infusion of the roasted seeds has sudorific properties (Kumar *et al.*, 2013).

The immature pods are also used in making pickles. Potential of mucilage for medicinal applications includes uses as an extender of serum albumin (Be Miller *et al*., 1993 cited in Habtamu Fekadu *et al.*, 2014), as tablet binder (Ofoefule *et al*., 2001 cited in Habtamu Fekadu *et al.*, 2014) and as suspending agent in formulations (Kumar *et al.*, 2009 cited in Habtamu Fekadu *et al.*, 2014). Okra mucilage is used in Asian medicine as a protective food additive against irritating and inflammatory gastric diseases (Lengsfelf *et al*., 2004 cited in Habtamu Fekadu *et al.*, 2014).

Mucilage, found in okra, is responsible for washing away toxic substances and bad cholesterol, which loads the liver. Okra possesses purgative properties which are beneficial for bowel purification.

Okra poses no threat and causes no addiction; it is completely safe and reliable. Moreover, it contains a bunch of useful nutrients and is cheaper than chemical alternatives. Fiber okra

contains is a valuable nutrient for intestine microorganisms. This ensures proper intestine functionality. Okra ensures recovery from psychological and mental conditions, like, depression and general weakness. Okra is an effective remedy for ulcers and joint healthiness. It also guards the mucous membranes of the digestive system, by covering them with additional layer. Okra is additionally applied for pulmonary inflammations, bowel irritations, and sore throat. According to Kumar *et al.* (2013), okra is a complex replacement for human blood plasma.

3. Chemical composition and pharmacological activities

Okra is a source of protein, Vitamins A and C, iron, and calcium and dietary fiber, Zinc, Iron, Magnesium, Calcium and phosphorous, Moisture, Protein, Fiber, Fat and Ash (Adetuyi *et al.*, 2011)**.** It contains large quantities of glycins, which are responsible for the viscosity of aqueous suspension and the stringy gum-like consistency that is particularly desirable in soups. (Chaudhari *et al*., 2011).

The fruit part of this particular plant is endowed with nutrients such as protein, niacin, riboflavin, phosphorus, zinc, copper, potassium, vitamins A, B6, C and K, thiamine, magnesium, foliate, calcium, and manganese (Ray *et al,* 2013). Okra is a powerhouse of valuable nutrients, nearly half of which, a soluble fiber in the form of gums and pectins, helps to lower serum cholesterol, reducing the risk of heart diseases, and; the other half, an insoluble fiber, helps to keep the intestinal tract healthy. Okra mucilage has medicinal applications as a plasma replacement or 'blood – volume expander.' The mucilage of okra binds cholesterol and bile acid carrying toxins dumped into it by the liver. Okra also has industrial applications and is used in confectionary **(**Adetuyi *et al.*, 2011).

3.1. **Antibacterial activity of *Abelmoschus esculentus***

The Ethanolic, butanolic and methanolic extracts of the fruit of *Abelmoschus esculentus* exhibited broad spectrum of antibacterial activity. It was observed in the study that the butanolic, ethanolic and methanolic extracts inhibited the growth of pathogenic bacteria approximately 90, 70 and 70% respectively (Chaudhari *et al.*, 2011; Doreddula *et al*., 2014).

The broad spectrum of antibacterial activity of these extracts was due mainly to the presence of active constituents in the extracts, which may be polar compounds like saponins. It was also observed that gram negative bacteria were more sensitive to most of the extracts tested compared to gram-positive bacteria. Among gram positive bacteria *B. subtilis* and *S.pyogens* were sensitive to butanolic and methanolic extract of fruit of *Abelmoschus esculentus* while *S. aureus* and *S. pyogens* were sensitive to ethanolic extract (Chaudhari *et al.*, 2011).

3.2. Antioxidant, antidiabetic and anti-stress activities

The aqueous and methanolic seed extracts of *Abelmoschus esculentus* possess antioxidant, antistress (adaptogenic), and nootropic activities. The study by Doreddula *et al*. (2014) also provides scientific evidence of the traditional claim of *Abelmoschus esculentus* fruits in stress-related disorders and dementia. In addition, these extracts significantly reduced the blood glucose, corticosterone, cholesterol, and triglyceride levels elevated by acute restraint stress. It has also been revealed that these extracts showed a significant antioxidant activity and no signs of toxicity or death up to a dose of 2000 mg/kg. Doreddula *et al*. (2014) reported that the seed extracts of *Abelmoschus esculentus* L. possess antioxidant, antistress, and nootropic activities which promisingly support the medicinal values of the species as a vegetable .

Subrahmanyam *et al*. (2011) showed that the anti-diabetic activity of *Abelmoschus esculentus* fruit extract in rabbits (2.5 kg).

References

Abeykoon, A.M.K.C.K., Fonseka, R.M., Paththinige, S. and Weerasinghe. K.W.L.K. (2010). Fertilizer Requirement for Densely Planted Okra (*Abelmoschus esculentus* L.). *Journal Tropical Agricultural Research, Sri Lanka* **21**(3): 275 – 283.

Adetuyi, F.O., Osagie, A.U. and Adekunle, A.T. (2011). Nutrient, antinutrient, mineral and zinc Bioavailability of okra *Abelmoschus esculentus* (L) Moench Variety, Nigeria. *American Journal of Food and Nutrition* **1**(2): 49-54.

Ali, M.B., Lakun, H.I., Sani, S.M. and Adamu, H.M. (2014). Effect of organic manure and sowing date on the growth and yield of okra (*Abelmoschus esculentus* Moench) in Samaru Zaria, Nigeria. *International Journal of Agronomy and Agricultural Research (IJAAR)* **5**(5): 111-117.

Amadi, J.E., Nnamani, C., Ozokonkwo, C.O. and Eze, C.S. (2014). Survey of the incidence and severity of okra (*Abelmoschus esculentus* L.Moench) Fruit rot in Awka South lga, Anambra State, Nigeria. *International Journal of Current Microbiology and Applied Science* **3**(4):1114-1121.

Chaudhari, Y., Kumar, E.P., Badhe, M., Mody, H. R. and Acharya, V.B. (2011). An evaluation of antibacterial activity of *Abelmoschus esculentus* on clinically isolated infectious disease-causing bacterial pathogen from hospital. *International Journal of Pharmaceutical and Phytopharmacological Research* **1**(3): 107-111.

Doreddula, S.K.,Bonam, S.R., Gaddam,D.P., Desu, B.S.R., Ramarao, N. and Pandy, V. (2014). Phytochemical analysis, antioxidant, antistress, and nootropic activities of aqueous and methanolic seed extracts of Ladies Finger (*Abelmoschus esculentus* L.) in Mice. *Scientific World Journal* **2014**:1-14.

Habtamu Fekadu, Negussie Ratta, Gulelat Desse Haki and Ashagrie Z. Woldegiorgis Fekadu Beyene (2014). Nutritional Quality and Health Benefits of Okra (*Abelmoschus esculentus*): A Review. *Global Journal of Medical Research: K Interdisciplinary* **14** (5):28-37.

Kumar, D.S., Ton, D.E., Kumar, A.P., Kumar, K.A., Rao, D.B.S. and Nadendla, R. (2013). A review on *Abelmoschus esculentus* (Okra). *International Research Journal of Pharmaceutical and Applied Sciences (IRJPAS) Guntur, Andhra Pradesh, India*. **3**(4):129-132.

Ray, T.J., Ricky. J.P., Mobarak, B. Pacalna, O., Sotero, O. and Malayao, J.r. (2013). Exploratory investigation on the hypoglycemic effect of *Abelmoschus esculentus* in mice. *International Journal of Scientific and Technology Research* **2** (11): 249-253.

Subrahmanyam. G.V., Sushma, A.A.M., Neeraja, Ch. Harsha, H.S.S. and Ravindra, J. (2011). Antidiabetic activity of *Abelmoschus esculentus* fruit extract. *International Journal of Research in Pharmacy and Chemistry India* **1**(1):17-20.

Torkpo, S.K., Danquah, E.Y., Offei, S.K. and Blay, E.T. (2006). Esterase, total protein and seed storage protein diversity in Okra (*Abelmoschus esculentus* L. Moench). *West Africa Journal of Applied Ecology (WAJAE) Ghana* **9**:1-7.