JETIR.ORG ISSN: 2349-5162 | ESTD Year : 2014 | Monthly Issue
JOURNAL OF EMERGING TECHNOLOGIES AND INNOVATIVE RESEARCH (JETIR)
An International Scholarly Open Access, Peer-reviewed, Refereed Journal

UNVEILING THE DIVERSE UTILITY AND NUTRITIONAL IMPORTANCE OF OKRA (*ABELMOSCHUS ESCULENTUS*): A THOROUGH EXAMINATION OF ITS ECONOMIC SIGNIFICANCE AND INDUSTRIAL PROSPECTS

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ABSTRACT: Okra (*Abelmoschus esculentus*), is a vegetable crop of great economic importance cultivated in tropical and sub-tropical regions worldwide. The main objective of this study was to assess the nutritional value and possible health advantages of the edible parts of Okra. This versatile crop offers a wide range of uses, including the consumption of its fresh leaves, buds, flowers, pods, stems, and seeds. The immature fruits of Okra, commonly eaten as vegetables, can be incorporated into salads, soups, and stews, either fresh or dried, fried or boiled, resulting in a mucilaginous texture after cooking. The extract derived from the fruit is frequently added to various dishes such as stews and sauces to enhance their consistency. The mucilage of Okra has medicinal properties, being used as a plasma substitute or blood volume expander. It has the ability to bind cholesterol and bile acids, which are toxins eliminated by the liver. Furthermore, Okra seeds are a promising source of oil, with oil content ranging from 20% to 40%, containing up to 47.4% linoleic acid. This oil is also rich in linoleic acid, a polyunsaturated fatty acid essential for human health.

Keywords: okra, nutritional, quality, health, edible oil.

I. INTRODUCTION

Okra (Abelmoschus esculentus) is one of the most widely known and utilized species of the family and an economically important vegetable crop grown in tropical and sub-tropical parts of the world. This crop is one of the most widely known and utilized species of the family Malvaceae.The okra plant was formerly a member of the Hibiscus genus. Later on, it was given the name Abelmoschus, which is different from the Hibiscus genus. Okra originated in Ethiopia and was then propagated in North Africa, in the Mediterranean, in Arabia and India by the 12th century BC. Abelmoschus esculentus (L.) Moench, commonly known as lady's fingers, is a plant that grows in many English-speaking nations. It is also known as bhindi in India, krajiab kheaw in Thailand, ochro, okoro, quimgombo, quingumbo, gombo, kopi arab, kacang bendi, and bhindi in South East Asia. However, it is referred to as gumbo in the South and as bamya, bamya, or bamieh in the Middle East. The names quiabo, quimbombo, gombo common, gombo, gumbo, mbamia, and mbinda in Sweden, as well as okura in Japan, are used to refer to okra in Portuguese and Angola, Cuba, and France. Okra is a crop with many uses because of the various ways in which its fresh leaves, buds, blossoms, pods, stems, and seeds can be used. Green seed pods, also known as immature okra fruits, are consumed like vegetables and can be added to salads, soups, and stews as well as eaten fresh or dry. It takes on a mucilaginous consistency after cooking. The fruit extract is often used to enhance the consistency of several recipes, including sauces, stews, and soups. Although okra is an oligo purpose crop, it is typically eaten as a vegetable in a variety of ways because of its soft, green fruits. Vitamins, calcium, potassium, and other minerals abound in these fruits. The thick, slimy substance present in both fresh and dried okra pods is referred to as okra mucilage. It can be used therapeutically

as a blood volume expander or as a substitute of plasma. The mucilage found in okra binds bile acids and cholesterol that the liver releases into the body, which contain toxins. The entire plant can be eaten and is utilized to make a variety of foods. The high protein content of okra seeds indicates its potential to treat protein deficiency. This is the reason okra seed was incorporated into regional traditional foods and folk medicine. Additionally, okra seed has been shown to have anti-oxidant and anti-inflammatory properties. Because okra seeds contain oil and protein, they have been used for oil extraction to a lesser extent. However, they can also be used as a substitute for coffee without caffeine. Okra also has industrial uses and is used in the confectionery industry. It is important to promote the use of native vegetables such as Okra, as they play an important role in preventing food insecurity and fighting malnutrition in the nation. World production of okra (both species) as fresh fruit-vegetable is estimated at 6 million /year.

II. NUTRITIONAL COMPOSITION OF OKRA

Okra is primarily considered a dietary food rather than a staple. Okra seeds have been used on a small scale for oil production. Because of fibre along with other nutrition, okra shows useful for minimizing blood sugar levels within the body, assisting along with diabetes. The fibre likewise helps support blood sugar levels level simply by slowing down sugar assimilation through the intestines. One hundred grams of okra also contain approximately 27 percent of our RDI of vitamin C and 50 percent of our RDI of vitamin K. Okra is known to be rich in high quality protein especially with regards to its content of essential amino acids relative to other plant protein sources. Hence, it plays a vital role in the human diet. Okra, which is currently grown mainly as a vegetable crop, has potential for cultivation as an essential oilseed crop because okra seeds contain high amount of oil (20-40%).The composition of okra pods per 100 g edible portion (81% of the product as purchased, ends trimmed) 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 mcg, riboflavin 0.08 mg, thiamine 0.04 mg, niacin 0.60 mg, ascorbic acid 47.00 mg. Potassium, Sodium, Magnesium and Calcium are the principal elements in pods, which contain about 17% seeds. Presence of Iron, Zink, Manganese and Nickel also has been reported. Fresh pods are low in calories (20 per 100 g), practically no fat, high in Fiber, and have several valuable nutrients, including about 30% of the recommended levels of vitamin C (16 to 29 mg), 10 to 20% of folate (46 to 88 mg) and about 5% of vitamin A (14 to 20 RAE). Both pod skin (mesocarp) and seeds are excellent source of zinc (80 mg/g). Okra seed flour could also be used to fortify cereal flour. For example, supplementing maize ogi with okra meal increases protein, ash, oil and Fiber content. The okra pods were reported to have viscous Fiber and lower cholesterol content. Its addition to predominantly high carbohydrate foods might be expected to enrich such foods and improve their nutritional status. Okra seed flour has been used to supplement ‘ogi’. Consumption of young immature okra pods is important as fresh fruits, and it can be consumed in different forms. Fruits can be boiled, fried or cooked. The sauce made from dried okra, combined with various ingredients and commonly enjoyed in West Africa, lacks beta carotene (vitamin A precursor) and retinol. Fresh okra pods are recognized as a significant vegetable source of viscous fiber, which plays a crucial role in reducing cholesterol levels in the diet. Among fresh okra pods, those that are seven days old contain the highest concentration of nutrients.

III. OKRA MUCILAGE AND ITS POTENTIAL

Mucilage is a polymeric gel that is exuded by most plant roots and is mainly composed of carbohydrates, amino acids, and organic acids, in addition to a smaller quantity of glycolipids and other phospholipids. Okra mucilage is the thick, slippery substance present in both fresh and dried pods. These slimy substances are typically concentrated in the walls of the pods and consist of acidic polysaccharides combined with proteins and minerals. Okra mucilage has been used as mucilaginous food additive against gastric irritative and inflammative diseases, has potential as hydrogels for tissue engineering applications, as binding or granulating agent and retardant material in the formulation of pharmaceutical solid dosage forms. Recently okra mucilage has been used as natural coagulant due to its water-soluble natural polysaccharides which are capable of flocculating small particles. A hot-buffer-soluble- solid fraction and an alkaline-soluble-solid fraction of okra polysaccharides were combined with whey protein isolate and glycerol to form blend edible films. Edible films developed in the present research might have potential to be applied as bioactive packaging without any additional antioxidant, since okra mucilage apparently has antioxidant activity, although such statement needs further investigation. Okra mucilage serves as an affordable and renewable biodegradable material. Its characteristics encompass strong water solubility, flexibility, resilience, and thickness. The majority of physical and chemical properties are impacted by variables like temperature, pH level, sugar and salt concentrations, and duration of storage. Mucilage in okra is however ubiquitous, thus can be found in almost all parts of the crop. The immature pods, seeds, stems, leaves, flowers, barks, roots and even the cell walls of the fruits harbour substantial amount of mucilage. Mucilage and gums in plants are known to facilitate water storage, decrease diffusion in plants, succour seed dispersal and germination, and act as a membrane thickener and food reserve. It is medically proven to be linked with anticancer, antimicrobial, hypoglycaemic, anti-ulcer activities, as well as its ability to bind cholesterol and bile acid carrying toxins by filtering the liver. The rheological behaviour of okra mucilage is pseudoplastic and can be used to enhance viscosity and stability in many food products such as stabiliser in ice cream, sauce and salad dressing; an ideal substitute for otherwise costly synthetic and semi-synthetic excipients. In Ghana and some parts of West Africa, mucilage is used to impart desired slimy consistency to local soups and stews. The potential uses of okra mucilage span across food, non-food products, and medicine. In food, it can serve as a substitute for whipping agent in reconstituted egg whites, an ingredient in flour-based adhesives, and a clarifying agent for sugarcane juice in India. Non-food applications include its use as a brightening agent in metal electro-deposition, a deflocculant in paper and fabric manufacturing, and a protective agent to minimize friction in pipe-flow. The potential medicinal applications of mucilage include its utilization as a serum albumin extender, tablet binder and suspending agent in formulations. In Asian medicine, okra mucilage is employed as a protective dietary additive to mitigate irritating and inflammatory gastric conditions.

IV. HEALTH BENEFITS OF OKRA

In recent times, there has been a growing focus on the impact of diet on human health. Consuming a large quantity of plant-based foods is linked to a decreased likelihood of developing several chronic conditions, including atherosclerosis and cancer.

1. Role of antioxidants:

Okra is also known for being high in antioxidants activity with different parts of the plant has reported in vitro antioxidant assay of methanol extract of okra fruits. In pulped seed catechin, procyanidin B2, epicatechin and rutin are reported to be present. It is quite important to the see that roasting (1600°C for 10– 60 minutes) increased the nutrient composition and antioxidant activity of the seeds whereas pre-treatment (soaking and blanching) increased the nutrient composition, but decreases antioxidant activity. The major antioxidants of vegetables are vitamins C and E, carotenoids, and phenolic compounds, especially flavonoids. These antioxidants scavenge radicals and inhibit the chain initiation or break the chain propagation (the second defence line). Vitamin E and carotenoids also contribute to the first defence line against oxidative stress, because they quench singlet oxygen. Flavonoids as well as vitamin C showed a protective activity to α-a tocopherol in human LDL, and they can also regenerate vitamin E, from the αchromanoxy radical. Nutrient antioxidants may act together to reduce reactive oxygen species level more effectively than single dietary antioxidants, because they can function as synergists. In addition, a mixture containing both water-soluble and lipid-soluble antioxidants is capable of quenching free radicals in both aqueous and lipid phases. For example, with the liposome oxidation method, the activity of combination of quercetin or catechins plus αtocopherol was significantly higher than the sum of the individual activities. Combinations of α-tocopherol or vitamin C plus phenolic compounds also provided synergistic effects in human erythrocyte membrane ghosts and phosphatidylcholine liposome systems.

2. Role in blood sugar level:

Okra contains high Fiber, which "helps to stabilize blood sugar by regulating the rate at which sugar is absorbed from the intestinal tract". Because of Fiber along with other nutrition, okra shows useful for minimizing blood sugar levels within the body, assisting along with diabetes. The Fiber likewise helps support blood sugar levels level simply by slowing down sugar assimilation through the intestines. Okra is used to stabilize blood sugar by regulating the rate at which sugar is absorbed from the intestinal tract. It is a good vegetable for those feeling weak, exhausted, and suffering from depression and it is also used in ulcers, lung inflammation, sore throat as well as irritable bowel. Okra is good for asthma patients and it also normalizes blood sugar and cholesterol levels.

3. Role in kidney health:

The frequent usage of okra might help avoid kidney disease. Within the research, "those who consumed okra every day decreased clinical indications of kidney damage a lot more than the ones that simply consumed a diabetic diet." This ties along with diabetes, as almost 50% of kidney disease cases are generated by diabetes.

4. Role in digestive disease:

Okra is used to treat digestive issues. The polysaccharides present in immature okra pods possessed considerable antiadhesive properties (i.e. they help remove the adhesive between bacteria and stomach tissue, preventing the cultures from spreading). Okra's polysaccharides were particularly effective at inhibiting the adhesion of Helicobacter pylori, a bacterium that dwells in the stomach and can cause gastritis and gastric ulcers if left unchecked. Therefore, eating more okra can keep our stomach clean and create an environment that prevents destructive cultures from flourishing.

5. Role in colon health:

Okra is used to supports colon health. It smoothly sails down our colon, absorbing all toxins and excess water in its path. Okra is filled with dietary Fiber, that is required for colon health and digestive health all together. The Fiber Okra offers helps to cleanse the intestinal system, letting the colon to operate at higher amounts of effectiveness. In addition, the vitamin A plays a role in wholesome mucous membranes, assisting the digestive system to function adequately.

6. Role in healthy skin:

Okra is used to supports colon health. It smoothly sails down our colon, absorbing all toxins and excess water in its path. Okra is filled with dietary Fiber, that is required for colon health and digestive health all together. The Fiber Okra offers helps to cleanse the intestinal system, letting the colon to operate at higher amounts of effectiveness. In addition, the vitamin A plays a role in wholesome mucous membranes, assisting the digestive system to function adequately.

7. Role in health of pregnancy:

Okra is used to promotes a healthy of the pregnancy. An incredibly essential B vitamin for creating and maintaining new cells, foliate is a vital substance for optimum pregnancy. The vitamin aids in preventing birth defects just like spina bifida and enables the baby to develop completely. Vitamin C is additionally required for baby development.

Okra is full of both foliate and vitamin C. The high quantity of foliate included in the okra is helpful for the foetus while pregnant. Foliate is a vital nutrient that increases the growth and development of the foetus' brain. The high quantity of folic acid within okra performs a huge role within the neural tube formation of the foetus through the fourth to the 12th week of pregnancy.

8. Role in heart health:

Okra is used to improves heart health. The soluble Fiber within okra helps you to reduce serum cholesterol and therefore decreases the chance of cardiovascular disease. Consuming okra is an efficient method to manage the body's cholesterol level. Okra is additionally loaded with pectin that can help in reducing high blood cholesterol simply by modifying the creation of bile within the intestines.

9. Role in eyesight:

Okra is also used to improves good eyesight. The okra pods are fantastic options for Vitamin A and also beta carotene that are both important nourishment for sustaining an excellent eye-sight along with healthy skin. Additionally, these types of important nourishment also assist inhibits eye associated illness along with the problems in the skin. Okra is better ingested when joined along with other healthy veggies. Consuming okra has truly numerous advantages, simply bear in mind to eat natural veggies as opposed to processed veggies.

10. Role in cholesterol:

Okra is used to controls the body's cholesterol level. There are numerous significant illnesses related to high cholesterol level of the entire body. Managing the body's cholesterol level is nearly difficult because it's hard to avoid foods loaded with cholesterol content. One of the better health advantages of consuming okra is definitely the powerful management of the human body's high cholesterol level. This healthy vegetable is beneficial in slimming down and also decreasing cholesterol therefore keeps a healthy and also low cholesterol body. Okra have been taken advantage by diet advisors due to these qualities.

V. CONCLUSION

The information provided emphasizes the potential nutritional benefits of Okra and its significance in enhancing health. Okra serves as an economical source of protein, carbohydrates, essential minerals, vitamins, dietary fibre, and beneficial fatty acids. While some scientific studies suggest that Okra components may help lower the risk of certain chronic diseases, there is limited understanding regarding how specific parts of Okra contribute to disease prevention and the underlying mechanisms. Unravelling these complexities requires further research to establish concrete evidence of the direct health advantages of consuming Okra. Encouraging the consumption of traditional vegetables like Okra could offer cost-effective access to essential nutrients for resource-limited farmers in Ethiopia and beyond. Additionally, Okra consumption holds potential in combating malnutrition, particularly among urban households with limited resources. Both low and high-income groups could benefit from incorporating Okra into their diets as a means of diversifying nutritional intake.

VI. ACKNOWLEDGMENT

This project was the most significant accomplishment in my life and it would not have been possible without the blessing of God almighty and those who supported me and belief in my Caliber.

My deep sense of gratitude and sincere thanks to Dr. NALLA. G. PALANISWAMI, M.D, AB (USA), Chairman, Kovai Medical Centre Research and Educational Trust and Dr. THAVAMANI. D. PALANISWAMI, M.D, AB (USA), Secretary, Dr. N.G. P Arts and Science College, Coimbatore.

I am thankful to our principal Dr. Dr.K. RAMAMURTHI M. Com BL MBA Ph.D., Dr. N.G. P Arts and Science College, Coimbatore, for every help he rendered before and during the project.

I owe my deepest thanks to Dr. D. SRIDEVI, M.Sc., M.Phil., PGDHM., Ph.D. Professor and Head, Department of Food Science and Nutrition Dr. N.G. P Arts and Science College, Coimbatore for showing sustained interest and providing help throughout the period of my work

I would like to extend sincere thanks to my guide, Ms. ANJALI M., M.Sc., Assistant Professor, Department of food science and nutrition Department of Food Science and Nutrition Dr. N.G. P Arts and Science College, Coimbatore. I sincerely thank for his exemplary guidance and encouragement.

I take this opportunity to acknowledge my sincere thanks to all the Staff Members of the Department of Food Science and Nutrition for their constant inspiration, assistance and resourceful guidance for the completion of this project successfully.

I express my sincere thanks to my family and friends for their encouragement love, prayers, moral support, advice and sacrifice without which I would not have been able to pursue the course of my study.

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