

A Review on Okra as an Antidiabetic, Antioxidant and An Excellent Energy Source



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Abstract

Okra is a vegetable which is still infamous in most of the countries owing to all the medicinal benefits it holds. It is an excellent source of nutrition and comes with a bundle of goodness. This review concentrates on okra being an antioxidant, anti-fatigue agent, anti-diabetic and most importantly anticancer therapeutic. Polysaccharides and fibres in okra are also known to be sources of energy and bio therapeutics from which essential drugs can be formulated. The review looks into the capacity of okra to replace most of the drugs in the treatment of several diseases. It also promises the chance of okra passing the different phases of the clinical trials.

Keywords: Polyesterols; polyphenols; flavonoids; Diabetes mellitus; Myricetin; nutraceutical; polysaccharides

Introduction

Human nutrition and metabolism are a credit of the vegetables we consume. These hold key molecules such as vitamins, antioxidants, phytosterols and fibre. These days' medicinal benefits of such vegetables is increasing rapidly and grabbing human attention. Isolated good stuff from these vegetables such as tannin, inoles, glucosinolates, carotenoids etc play a vital role in regulating various diseases including the one known to be most popular, Diabetes mellitus. Research says that one such vegetable is known to be the infamous Okra. Metabolic products such as indole-3 carbinol from the seeds of okra are known to be examined in the treatment of several cancers [1]. Okra (*Abelmoschus esculentes*) widely grows in most of the countries all around the world but is seen to be heavily concentrated in the regions of Africa. The maturity period of the okra is said to be between 60-180 days and was known to be a minor crop until its potentials were discovered. It is known to be a solution for various health complications as 85% of the vegetable is water and the rest comprises of the different metabolic products embedded in the mucilaginous substance. It is also practised as a traditional medication in an array of cultures.

The unique combination of seed protein rich and balanced in tryptophan and methionine makes okra carry all the medicinal benefits. The seeds are also known to be used in the production of oils and more interestingly it can now be used

as a substitute for non-caffeinated beverages. Owing to the dietary fibre present within, the seed powder can be used in water treatment procedures as a substitute to aluminium salt. Okra contributes to be one of the best antioxidants and as a chemo-preventive agent by inhibiting the growth of cancer cells by proper signalling mechanisms. The antioxidant property is due to the oligomeric catechins and derivatives of flavonoids which are potent antioxidant key factors [2]. There are several species of okra and bhindi being one of them is said to have a low yield comparatively. To overcome this limitation, genetic architecture including recombination and hybridization are carried out [3]. The striking feature of okra is seen in the treatment of the worldwide epidemic Diabetes mellitus wherein okra acts as an anti-diabetic nutraceutical. This property arises due to the presence of medicinal phytochemicals and dietary fibre. Proximate functional properties of okra include, water adsorption capacity, oil adsorption capacity, glucose adsorption capacity, and glucose dialysis.

Glucose dialysis retardation unit of patients with diabetes show reduced blood sugars due to decreased glucose adsorption. Derivatives of hydroxycinnamic in okra explain the actual antioxidant functions and its potential beneficial benefits in the treatment of fatigue and several cardiovascular diseases [4]. These nutraceuticals isolated from okra are much required in regulating diabetes rather than the allopathic drugs which come

alongside with several side effects. In the treatment of diabetes, the okra seeds and pods are widely used. The seeds preserve most of the proteins, fat and sugar whereas the pods are rich sources of dietary fibre. Okra is also filled with flavonoids which add to the antioxidant property by inducing the hypolipidemic effect in which the adsorption of cholesterol gets reduced from the diet therefore regulating diabetes as well as several complications related to the heart hence reducing fatigue [5]. Scientific evidence shows that dried okra seeds have no nutritional benefits whereas seven day old fresh seeds have the highest amounts of beta carotene [5]. Modern research along with scientific evidence revealed the complementary and hypoglycemic activity of okra. Sabita has reported the anti-diabetic and antihyperlipidemic activity of okra peel and seeds in diabetic rats induced with streptozotocin. It is known that the anti-diabetic activity is seen in its peak when aqueous extracts of the seed powder is used.

Okra works on targeting the enzymes such as ALP, AST and so on. Okra therefore acts in improving insulin resistance and therefore preventing it from being lost in diabetics. As the vegetable is known to have zero fat and high fibre, studies reveal that okra in the form of soup is known to be the best dietary supplement for patients with AIDS. It is seen that people with HIV are known to have a low metabolic rate and dysfunctional digestive system; hence this soup called as the Egusi serves the purpose. There is evidence of this supplement helping in antiretroviral therapy in African countries with HIV/AIDS prevalence. World Health Organization reported that in order to maintain a good health status in people with HIV a good diet

is one of the primary solutions. The presence of malnutrition in AIDS patients presents a dangerous circle with amplified health complications. In order to maintain a decent immunity which in fact is a challenge, it is hence prescribed to provide a sumptuous yet nutritious diet and this is possible with the addition of okra. As the vegetable is rich in macronutrients an array of supplements can be created such as the Egusi okra meal, the okra soup, water fufu etc. The okra seeds represent 17% of the whole vegetable containing phenolic and catechin compounds. The seeds are rich in palm oil therefore serving as a source of fat and provitamin A carotenoids making it a potential drug in the treatment of Vitamin A deficiency [6].

Owing to the high fibre content studies reveal that okra bast fibre can substitute flax. In the earlier times farmers preferred growing fibrous seeds such as flax as they yield higher yarns and hence can be beneficial but as these yarns let out toxic chemicals and lead to decline in landfill spaces, okra having higher lignocellulosic fibres can be used for the same emotive and thereby provide higher yarn yield and also have higher dietary fibre content. These agro based fibres in okra possess similar benefits as that of the flax and interestingly is also known to be a powerful renewable source of energy. The fibres isolated from okra have low density, decreased production tool wear, good biodegradability, high energy recovery and most importantly less cost. Production of such fibres from okra does not require the use of additional fertilisers and pesticides. These bast fibres are hence to have immense tensile strength and mechanical properties [7].

Chemistry Behind the Goodness of Okra

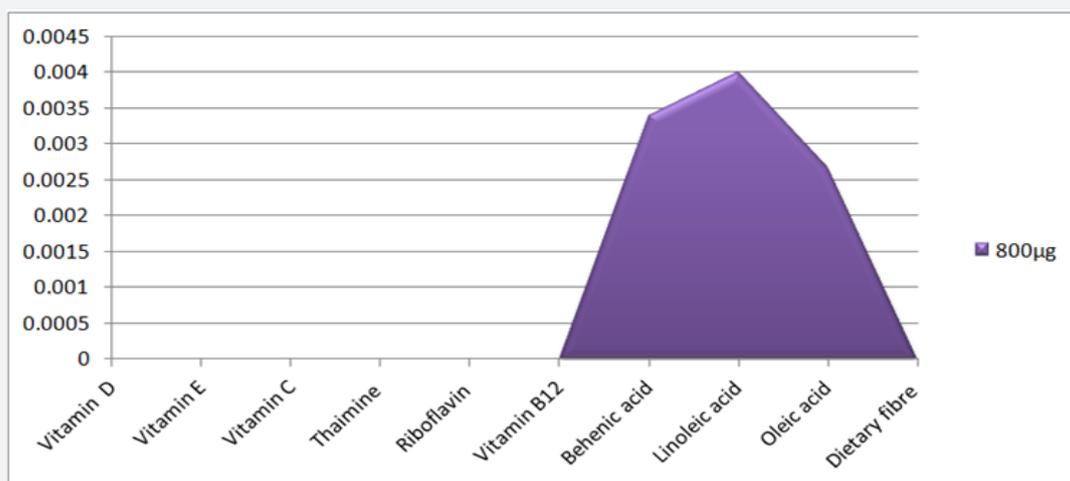


Figure 1: Graph representing the total nutrient composition of Abelmoschus esculentus.

Benefits of okra are due to the constituents that it holds which adds to its innumerable applications. The chemical composition of okra differs in a genotype dependant manner and also shows the best results when harvested early. The size of the vegetable is also dependent on the genotype and is known to

have all the goodness in the early stage of its growth. Harvesting at early stages is known to exhibit an increased nutrition value [8]. The edible part of the fruit contains 1.9g protein, 0.2g dietary fibre, 6.4g starch, 66mg calcium, 56mg phosphorous, 0.35mg iron, 6.98mg sodium, 103mg potassium, 0.19mg copper, 30mg

sulphur, 88IU of Vitamin A, 0.7mg thiamine, 0.1mg riboflavin, 0.6mg nicotine acid, 13mg of Vitamin C and 89.6g moisture [3]. The moisture in turn holds the mucilaginous substance which is rich in lingo cellulose thereby making okra have immense mechanical strength when consumed. The seeds of the okra have different functions while the pods and the fibres are involved in different activities altogether. It is also observed that the nutritional value keeps diminishing as the vegetable starts aging and also when it loses the moisture content. The antioxidant and the ant fatigue property of the okra are due to the phenols and the flavonoids present in the pods and this is ranges from 4.66-49.93mg/g and 18-18.72mg/g respectively [9]. The mucilage present in the highest concentrations is known to provide emulsifying properties to the okra which is ~ 43-75.45%, the adsorption capacities of water and oil seen in okra is found to be 2.45-4.60ml/g and 0.02-3.64ml/g respectively. Studies show that the mechanical, tensile and the elastic properties of okra were found to increase with the increase in the fibre content. The flexural strength at 15% fibre loading was 17.78±0.89, 33.55±1.67 and 60.01±3.01MPa respectively [10]. Okra is also known to work as a substitute for fat as it contains most of the essential oils in the range of 32.9-37.9% respectively. Major fatty acids present in the fruit include stearic, palmitic, oleic and the highest being linoleic acid [11] (Figure 1).

No More Fatigue with Okra!

Fatigue is a physiological phenomenon resulting in decreased voluntary activities. It is known to increase with age and immense physical activity. Research suggests that one of the key factors of cancer is actually depression and fatigue. Long term conditions actually lead to chronic syndromes and organic illness, and also to a condition called as karoshi meaning death due to the occurrence of cardiovascular diseases [12]. Earlier studies have confirmed that the presence of polyphenols and flavonoids contribute to the anti-fatigue properties. To prove this, ferric chloride solution was used as a reagent, and this was made to react with the okra seeds. The result showed a strong phenolic reaction. Surprisingly, there was no phenotypic change observed in the okra seed. This confirmed that the polyphenols and the flavonoids are the vital constituents of okra contributing as an antioxidant and as an anti-fatigue agent [13]. Fourier Transform near Infrared (FT-NIR) spectroscopy studies has also confirmed okra to act as an anti-fatigue agent. In this research, 120 samples of different okra specimens were analysed and FT-NIR showed the presence of the flavonoids and the polyphenols. Further quantification of the actual derivatives of the constituents such as the isoquercetin, 1-diphenyl-2-picrylhydrazyl, total phenols were represented in the form of peaks, thus confirming the role of phenols in the anti-fatigue activity [14,15] (Figure 2).

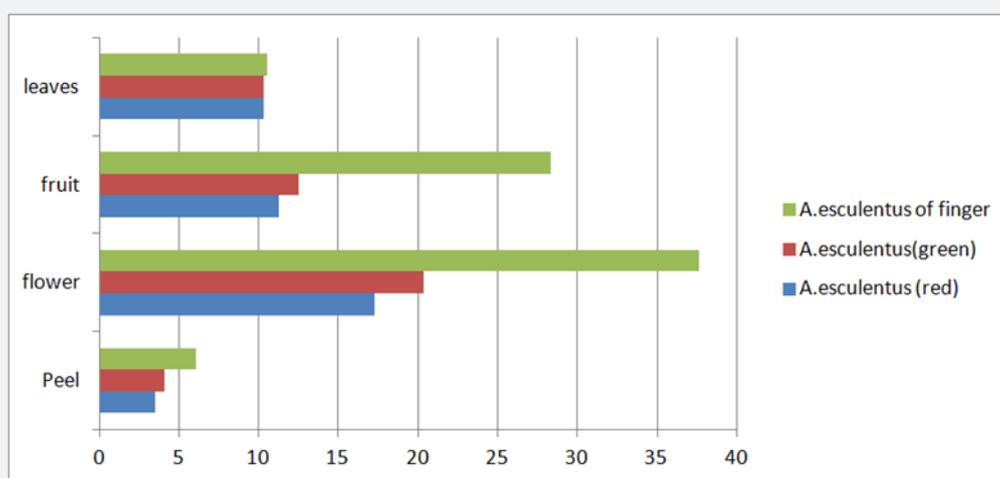


Figure 2: Bar graph representing flavonoid content in different parts of *Abelmoschus esculentus* [15].

Is Okra Taking Over Myricetin?

Scientific experiments on diabetic mice injected with the polysaccharides from the okra seeds were found to be successful in reducing the blood sugar levels by gradual decrease in the adsorption of cholesterol and blood sugar from the diet. Research was then continued to isolate the actual carbohydrate performing the function and it was recognised as a polysaccharide known as rhamnogalacturonan. This bio-molecule exhibited immense hypoglycemic activity [16]. Regulation of diabetes also requires pharmacological management by exploiting certain agents

which trigger the secretion of insulin using specific agents such as sulphonylureas which is also known to reduce the adsorption of glucose in the human diet. Furthermore the polysaccharides present in the okra pods and mucilage is also seen to decrease hepatic glucose production. Ironically if a diabetic would prefer allopathic medicine over the natural approach, the person will have to include drugs such as, biguanides, thiazolidinediones etc, these come with several side effects and also reduces the metabolic rate of the body. Scientific literatures in the past have confirmed the presence of active components which make okra an anti-diabetic. Hence it is necessary that the vegetable should

be used whole as an Active Pharmaceutical ingredient (API) instead of using chemicals such as Myricetin or Kaempferol as an API [17]. In this way by understanding the benefits of okra in

the treatment of several diseases, it can be sent to undergo the first phase of clinical trials so as to limit the use of animals in the formulations of several medicines (Figure 3).

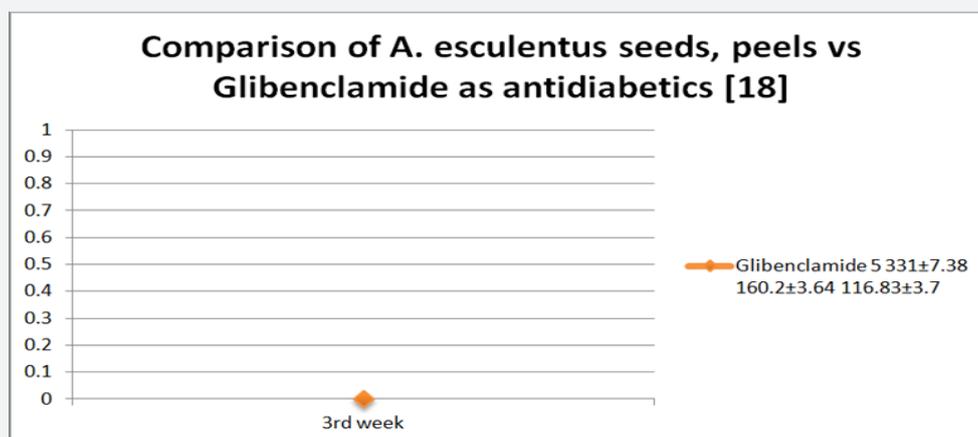


Figure 3: Line graph representing highest antidiabetic activity of *A.esculentus* seeds at 200mg/kg dosage.

Future Perspectives of Okra Research

Okra suits the title of being called as a super vegetable as it comes in with so many attributes and still is so infamous. The fact that it can be a complete anti-diabetic with no side effects just says it all. Apart from this, scientific study also proves the potential of okra to be called as a competitive source of pharmaceutical material as a nutraceutical [18]. The polysaccharides present in the mucilage are experimented so as to increase its volumes and isolate essential drugs. These nutraceuticals not only act as medicines but also work dietary supplements [19]. Okra is also reported to have biological importance as an antioxidant, as an anticancer therapeutic as well as anti-inflammatory agent. There is also scientific evidence which proves that okra exhibits immunomodulatory response during bacterial infections. This response was seen when the polysaccharides from the okra pods were immunised into the B lymphocytes of the mice infected with *Staphylococcus aureus*. This was then administered by evaluating the spleen weight at different intervals of time at different doses. Experiments confirmed that the spleen weight was found to increase with the increase in the dosage of the polysaccharide. Hence it proves that there is a positive correlation between the spleen weight and the proliferation of B lymphocytes by 74%. The results revealed that the polysaccharide improved the immune response and therefore is an ideal nutraceutical [20].

Reports suggest that the gelatine can be replaced with okra mucilage to improve the properties of the cake batter. This gum is usually extracted from the okra pods using NaOH solution. Rapid Viscosity analyser profiles have illustrated that there is increase in the viscosity of the batter with the increase in the okra gum [21]. As okra is rich in nutrients, genetic breeding of the pure lines with different genotypic constitution proved to produce their generations with increased micronutrient levels. The highest value of genetic coefficient of okra was found in iron and hence when this was crossbred it produced high quality

offspring [22]. Okra fibres are also considered to be potential energy resources. The biomass from the okra is biodegradable, cost efficient and a low density source in order to produce bast fibres.

Research on the bast fibres is on a rapid scale as it is eco-friendly and does not emit any hazardous chemicals. The composition, modification and the properties of fibre is studied and they are known to have excellent mechanical strength, high cellulose content, immense stiffness and most importantly good thermal resistance [23]. This review therefore brings together the importance of the vegetable as a whole. From these studies it is highly recommended that the vegetable in its different forms must be facilitated to undergo phases of clinical trials so as to exploit the different uses of the okra pods, peels, flowers etc. The infamous okra is so striking that each section of the vegetable holds unique properties which is still yet to be discovered.

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