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Anchote Research in Ethiopia and Achievements: A Comprehensive Review

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***Abstract:** Anchote (Coccinia abyssinica L.) is a vital tuber crop that belongs to the family Cucurbitaceae and is cultivated mainly for food, as its most important energy source, and medicinal uses in the tropics. In Ethiopia, Anchote is grown in some areas of the western and southern regions, offering several advantages over other cereals as a food staple in areas with poor soil conditions, uncertain rainfall, and weak market infrastructure. Despite research on crop adaptability, selection, nutritional, and anti-nutritional factors, there is a lack of information on the overall status, challenges, and the future role of Anchote production in Ethiopia. This paper, therefore, aims to provide a brief overview of the genetic improvement, agronomic research, nutritional aspects, biochemical analysis, anti-nutritional factors, disease and insect pest management, and future research directions of Anchote in Ethiopia. Different research findings have been obtained and registered since the inception of research on Anchote in Ethiopia, including agronomic practices, technologies, biochemical analysis for nutritional composition, and anti-nutritional factors. The availability of these outputs in a compiled and comprehensive way is essential for enhancing the production and productivity of Anchote in Ethiopia and to influence the policy makers to consider Anchote underutilized crop not known by most of the country so as enabling to introduce scale up to be known as one of the prominent food and nutrition security crops in the country. Hence, the article can serve as a valuable reference resource for researchers, students, agricultural extension workers, and NGOs working in Ethiopia in the area of root and tuber crops, in general, and Anchote in particular.*

***Keywords:** Breeding, Biochemical, Crop Protection, Food Security, Productivity*

Abbreviations:
LPS: Leaf Protein Concentrates
PA: Phytic Acid
FYM: Farm Yard Manure
EIAR: Ethiopian Institutes of Agricultural Research
ANFs: Anti-Nutritional Factors
IP6: Inositrol hexaphosphate
NPSB: Nitrogen, Phosphorus, Sulphur and Boron
HCN: Hydrogen Cyanide
CG: Cyano Glycoside

I. INTRODUCTION

Anchote (Coccinia abyssinica (Lam.) Cogn.) is a tuber crop that belongs to the family Cucurbita ceae. The genus Coccinia comprises approximately 30 species, of which eight occur in Ethiopia. Different vernacular names also know it in various places and among other tribes, and its cultivation as a root crop is common in the Wollega, Iluababor, Jimma, Kaffa, and Sidama Zones of Ethiopia [9]. It is mainly cultivated in backyards and rows in the southern, southwestern, and western parts of the country. C. ab yssinica is the only species cultivated for its edible tuberous roots and leaves. It has perennial trailing shoots. Underutilised species are defined as those with underexploited potential for contributing to food security, health and nutrition, income generation, and environmental protection. Underutilised species may have different terms or names, such as neglected, underutilised, minor, orphan, underexploited, underdeveloped, lost, new, novel, promising, alternative, local, traditional, and niche crops. If underutilised crop species are continued to be forgotten by research and development, the genetic diversity due to a lack of attention might be lost [27]. Underutilised species may have various terms or names, including neglected, underutilised, minor, orphan, underexploited, underdeveloped, lost, new, novel, promising, alternative, local, traditional, and niche crops. *Among the underutilised species of root tuber crops, C. abyssinica is widely grown and utilised in the western, southern, and southwestern parts of Ethiopia, with limited research coverage and lower attention given to this crop species at both national and regional levels. According to the anchote germplasm collection records of the Ethiopian Institute of Biodiversity, the majority of anchote accessions were collected from Oromia Regional State, mainly from Wellega, western Ethiopia, which has a long history of cultivation and a diversified tradition* of consumption. The root yield of different Anchote accessions ranges from 42 to 76 t ha-1. Anchote can withstand dry conditions and produce food for the poor smallholder farmers when other crops fail to grow. Typically, farmers sow Anchote seeds in April or May and harvest them in July or August [31].

Despite research on crop adaptability, selection, nutritional, and anti-nutritional factors, there is a lack of information on the overall status, challenges, and the future role of Anchote production in Ethiopia. This paper, therefore, aims to provide a brief overview of the genetic improvement, agronomic research, nutritional aspects, biochemical analysis, and anti-nutritional factors, as well as future research directions of Anchote in Ethiopia.

II. DESCRIPTION OF ANCHOTE

Anchote (*Coccinia abyssinica (Lam.)* Cogn) is a root and tuber crop cultivated for human consumption in the South-western areas of Ethiopia. Anchote belongs to the Cucurbitaceae family,

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one of the major families in the plant kingdom, encompassing about 115 genera and 960 species. Among the other root crops grown by Ethiopian farmers, Anchote is less prevalent, particularly in the central and southeastern areas of the country. In Ethiopia, Anchote is locally known by different names, such as Ancootee in the Oromo language. It is also called: Ushushu (Welayita), Shushe (Dawuro), and Ajjo (Kafigna) [30]. Anchote grows principally for its tuberous root, named 'Ancootee' in Afan Oromo. Its leaves are edible when cooked as a green vegetable, making it a multipurpose crop.

A. Agro-Ecology of Anchote

Anchote is adaptable to a variety of agro-ecological zones, with an altitudinal range of 550 m above sea level in the Gambela area to 2,800 m above sea level in the Kelam Wollega zone, and an annual rainfall range of 950 to 2,000 mm. It grows well in soils with a pH ranging from 4.5 to 7.5, a mean minimum and maximum temperature of 12°C and 28°C, respectively, and an annual rainfall of 800 to 1200 mm [7]. Anchote production and use in Ethiopia is unusual in that the crop is cultivated in a wide range of environments, encompassing various altitudes, rainfall patterns, soils, and farming systems. Despite their significant contributions to food security, income production, dietary energy provision, and resource base conservation, the food potential of root and tuber crops has not yet been fully tapped and utilised [13].

Apart from cereals and pulses, Ethiopian agroecosystems are highly suitable for the production of high-quality roots and tubers. Members of the Cucurbitaceae family are herbaceous annuals or perennials with a storage root and mostly moist vines. They grow either prostrate along the ground or climb using tendrils. Their tendrils can be branched or simple and are generated at the base of the petiole. There are usually four arched filaments coiling with an adhesive texture.

Anchote (Coccinia abyssinica) has shoots with simple tendrils and leaves that are palmately simple, with five lobes, while the shape varies from a heart to a pentagonal form. Its flowers are unisexual, having pistillate flowers at the nodes and staminate flowers in racemes. Fruits are red and yellow at maturity, and have an oval to cylindrical shape with 8.83 cm length, containing an average of 153 seeds. Unlike many other crops, Anchote can be grown with minimal inputs and produces reasonable yields in conditions of low soil fertility, acidic soils, drought, and in intercropping with cereals. It is a co-staple crop during the hunger months in certain pockets of western Ethiopia.

III. CONTRIBUTION OF ANCHOTE

A. Anchote as a Food Crop

In Ethiopia, Anchote is cultivated over a wide area, including Western, Southeastern (Western Sidamo, Gamu Gofa, and Shewa), Central, and Eastern Ethiopia (Shewa and Hararge), as well as Gojjam. Anchote is, however, cultivated mainly in the Western part of Ethiopia, in the Oromia Region, for a long time, and has diversified uses as a traditional and medicinal plant. The most economically valuable part of Anchote is the tuberous root, which has diversified potential for food, animal feed, medicinal purposes, and starch production, contributing to food security, income generation, and resource base conservation.

B. Anchote as a Feed Crop

Anchote is one of the most drought-tolerant crops and can be successfully grown on marginal soils, yielding reasonable yields where many other crops struggle to thrive. Both roots and leaves are suitable for use as livestock feed. Anchote offers tremendous potential as a cost-effective source of feed energy for livestock, provided it is well-balanced with other nutrients. One of the desirable qualities of anchote as a tuber crop is its good keeping quality. The tubers can be stored in an underground pit and retrieved when needed, providing food security in times of other crop failures. Although information on nutritional and anti–nutritional contents of anchote's leaf and seed is limited, the root has been better studied and reported as possessing a higher nutritional content than other widespread root and tuber crops. Unlike many different crops, Anchote can be grown with minimal inputs and produce reasonable yields in conditions of low soil fertility, acidic soils, drought, and in intercropping with cereals.

C. Economic and Social Importance

Seedlings of anchote tubers and leaves are used for current purposes, and anchote seeds are used for propagation, generating income for growers. The price for anchote tuber varies with tuber size, time of year, supply amount, and market location. In the western parts of the country, tubers of anchote are boiled and prepared with local butter for the Meskel holiday in September, which commemorates the discovery of the True Cross. It is also a current experience that" lanqaxaa", a finely prepared anchote dish, is commonly served during ceremonies marking weddings, betrothals, birthdays, and religious celebrations, New Year's Day, and Thanksgiving Day for the harvest, as well as on other occasions [32].

IV. NUTRITIONAL VALUE OF ANCHOTE

A. Anchote Tubers

Root and tuber crops mainly provide energy in the human diet in the form of carbohydrates and calories, yielding more per hectare per day than other crops. the tuberous root with diversified potentials for food, animal feed, medicinal and starch production, towards food security, income generation, and resource base conservation [11]. In Oromo society, women store the seed of Anchote in either clay or wooden pots. This will maintain the seed's shelf life at the desired level. The raw Anchote tuber contains organic (carbohydrate, crude protein, crude fiber) and inorganic substances (calcium, magnesium, iron) as well as low levels of anti-nutrients (oxalate, tannin, and cyanide) except phytate, when compared to other tuberous crop plants [29].

Vegetables hold special importance in human nutrition, as they facilitate the complete assimilation of vitamins in the human body and are rich in numerous minerals, such as Ca, K, Fe, and Na. Many species of Vegetables also contain high amounts of digestible carbohydrates (starch, sucrose, glucose, and fructose) and non-digestible carbohydrates (cellulose, hemicelluloses, and pectin), as well as proteins [18]. A polysaccharide molecule called starch is found in nature and is both cheap and renewable. The primary and characterising feature of anchote (Coccinia abyssinica) starch is its use in generating bio-ethanol from its pulp/waste. Anchote (*Coccinia abyssinica*) starch was extracted, and the pulp from the tuber was peeled, and the supernatant was isolated for bioethanol production. The extracted starch from anchote and bio-ethanol from pulps were characterized by physicochemical, functional properties and FT-IR analysis

B. Anchote Leaves

Leafy vegetables are the cheapest and most abundant source of proteins because of their ability to synthesize amino acids from a wide range of virtually available primary materials such as water, carbon dioxide, and atmospheric nitrogen as in legumes. Leaf proteins can be considered as the world most abundant protein source which is synthesized with a direct and efficient utilization of solar energy. Leaf protein concentrates (LPCs) also have a favourable amino acid composition, which could be used effectively to supplement traditional cereal-based diets commonly used in most developing countries. Leaf protein concentrates (LPCs) also have a favourable amino acid composition, which could be used effectively to supplement traditional cereal-based diets commonly used in most developing countries. Anchote has a significant amount of protein in its leaves and can be a valuable source for producing leaf protein concentrate for both human food and animal feed. In addition, the tuber and leaf of Anchote can also be used as a food ingredient and for new food product development, as the nutrient composition of Anchote shows its potential for various food formulations, specifically due to its high protein content [5]. Recognizing the nutritional importance of Anchote indicate that its young leaves cooked used as vegetable.

V. OPPORTUNITIES AND CONSTRAINTS OF ANCHOTE PRODUCTION

A. Opportunities of Anchote Production

Anchote starch exhibits several remarkable characteristics, including high purity, excellent thickening properties, a neutral taste, desirable textural properties, and a relatively inexpensive source of raw material, making it a superior alternative to other starch source crops such as maize, wheat, sweet potato, and rice. The process of starch extraction is also relatively simple, which makes the processing of Anchote starch particularly suitable for developing countries like Ethiopia. Moreover, the market for starch products can be increased by using starch as a biodegradable packaging material, in response to the world's concern about environmental issues. Hence, the biofuel crop Anchote has the advantage that the root can remain in the ground for months without deterioration, allowing for carefully planned and continuous harvest schemes. The crop is also resilient to poor environmental conditions, such as low rainfall. Anchote roots are not as voluminous as sugarcane or sorghum stalks, and thus, it makes it easier and cheaper to transport. Moreover, Anchote could serve as a potential food source to alleviate protein-energy malnutrition by providing essential nutrients to the diet. Based on the existing evidence, both tubers and leaves are nutritious, making Anchote a dual-purpose crop that can serve as a potential food source for the indigenous inhabitants of Anchote's growing areas, thereby ensuring food and nutritional security.

Anchote (*Coccinia abyssinica*) significantly contributes to the food security of millions of resource-poor farmers in the southern and southwestern regions of Ethiopia. Due to their high nutritional content, these crops offer essential health benefits that help reduce the risk of micronutrient deficiency. The crops can be easily grown in a home garden and also fit into an intercropping system, which can increase their multiple benefits for local farmers.

The genetic resources of the two crops have been maintained and developed by local farmers, and their wild relatives also exist in their natural habitats, primarily in similar agroecologies, mainly in southern and southwestern Ethiopia. Therefore, there is great potential to maintain their diversity in the area by creating awareness among farmers and adopting a participatory approach. Collaboration with development agencies and regional and international conservationists is also essential. Additionally, scientific research and development on these crops are crucial for improving the potential benefits that can be obtained from them, including their utilisation and economic benefits. A Comprehensive genetic diversity study on these minor crops is also required for effective conservation and sustainable use

B. Constraints of Anchote Production

The loss of variability from crop populations in diversity centres, i.e. areas of domestication and secondary diversification, is referred to as genetic erosion [15]. The term "genetic erosion" is often used narrowly, referring to the loss of genes or alleles, and more generally, to the loss of genetic variety. It is a process that affects both wild and domesticated species. It is both natural and artificial, or artificial. Naturally, it occurs when there is inbreeding between members of a small population that reveals deleterious recessive alleles. It causes a population "bottleneck" by shrinking the gene pool or narrowing the genetic diversity available. Genetic erosion in cultivated plants refers to the loss of population diversity, which is characterised by the reduction of heterogeneity in alleles and genotypes, along with their associated morphotypes and phenotypes. In Ethiopia, crop genetic diversity is critically endangered due to a high rate of gene erosion caused by natural disasters, population preferences, agricultural pressure, market modernisation, urbanisation, high pest and disease pressures, and changing cropping patterns resulting from climate change and environmental degradation. Due to human interference, the rate of genetic degradation in crops and their wild relatives is increasing at an alarming rate [24]. Drought has significantly degraded biodiversity in the nation over the last few decades. Furthermore, the causes, consequences, and extent of genetic erosion on local landraces, as well as the list

The number of varieties/species lost in various sections of the nation remains unclear. Furthermore, the causes and consequences of agricultural genetic resource genetic degradation are poorly recognized in Ethiopia. Through view of this, farm holding fragmentation, which allows farmers to keep landraces in at least one field; increased cultivation of marginal land, where landraces have an advantage over modern varieties; economic isolation, which creates market distortions that give landraces a competitive advantage; and cultural values and preferences for diversity are all critical factors in preserving crop diversity. Similarly, farmers' local knowledge of crops and agricultural diversity is being lost due to similar reasons. According to a survey report, [19] farmers in Southwest Ethiopia verbally revealed several local names of agricultural landraces that were no longer found in their districts/regions and were deemed to be lost.

VI. ANCHOTE RESEARCH IN ETHIOPIA

A. Genetic Improvement

Crop improvement is underway in various agro-ecological locations across the country. Efficient utilization of anchote genetic resources requires comprehensive and systematic collection, evaluation and characterization [10]. To this effect, multivariate analysis has, amongst others, proved helpful in the characterisation and classification of plant genetic resources evaluated for several phenotypic and agronomic traits. To alleviate the problem and provide farmers with alternative varieties, reports are in development for the mass propagation of some Anchote accessions in Ethiopia. According to [16], production of anchote still depends on local varieties maintained by farmers. Small plants with larger fruits produce smaller tubers; therefore, smaller fruits are the source of planting material. The seeds are extracted from the mature fruit flesh, which is then mixed with wood ash. The seeds are dried in the sun to the desired level of moisture, stored for the next growing season, and kept in clay or wooden pots or wrapped in a piece of cloth. Mother plants, known as guboo, are planted in the home gardens and used as the source of seeds for further planting. The seeds are sown at the beginning of summer by broadcasting, followed by covering with soil at a spacing of about 20 cm. Spacing in the rows highly affects the root yield, whereas spacing between the rows affects the root yield and the average root weight per plant. When the spacing within inter and intra rows was from 40 to 10 cm, the total tuberous root yield increased by 137%. The rate and percentage of germination of anchote seeds were evaluated under various in vivo and in vitro conditions, revealing significant variations. This implies that environmental factors can influence both the rate and the cent of seed germination. It is well known that the duration of seed storage affects not only germination efficiency, but also further growth and development of plants. Germplasm introduction and evaluation: The second approach being practised by the Anchote improvement program scheme involves the collection of locally available Anchote germplasm and the selection of the best genotypes. The third approach, crossing and evaluation of progenies for various traits, which is still in its infancy, was less practised in Ethiopia until recently.

B. Agronomic Research

In identifying suitable legumes for Anchote-legume intercropping, the intercrops of common bean, cowpea, soybean, and mung bean increased land use efficiency, suggesting that the actual productivity was higher than expected when anchote was intercropped with these legumes. Thus, farmers producing anchote have the option to plant with grain legumes, thereby obtaining alternative crops that minimise risk and utilise the land more efficiently. Plant density (inter- and intra-row spacing): The optimal row spacing is 40 cm, and the optimal plant spacing is 10 cm for Anchote production. However, plant density may vary depending on the type of soil and environment. A study on the effects of harvesting stage and cultivars on starch quality and quantity showed that the highest pH and viscosity of tuber starch were observed when Anchote was harvested at 3-5 months after harvesting [3]. However, a planting date trial carried out showed that Anchote seed planted in April or May and harvested in July or August is suitable for growing areas in Ethiopia. At planting, there should be sufficient moisture to achieve 80-90% germination; however, if the soil is waterlogged, aeration and root formation are usually hindered. Land preparation typically begins around February or March, preceding the onset of the rainy season. Land needs to be ploughed three times to increase water retention, control weeds, and facilitate seed germination [12]. However, manual harvesting required deeper digging, more labour and time in furrow planting compared to others. Therefore, planting a few reports deal with aspects of growth and yield of anchote (Coccinia abyssinica L.) in response to farmyard manure (FYM) and phosphorus (P) fertiliser rates in Ethiopia [1]. Most of the references on anchote are often scant and fragmentary. This is the outcome of research neglect that anchote and other traditional endemic crops have been subjected to in the past. Consequently, anchotes are hardly known to many researchers and policymakers. It is a significant crop, particularly in the western and southwestern regions of the country. Despite its importance, almost no research was carried out on the productivity of the crop. There is not much research done in nutrient management on Anchote, but it was reported that Anchote requires highly fertile soil for efficient growth of nutrients [17]; It was reported that Farm yard Manure and Blended fertilizer (NPSB) affected days to physiological maturity, Vine number, Vine length, Marketable root yield and other parameters [25]. The highest total root yield was recorded at 175 kg ha^{-1} NPSB and 10 t ha^{-1} FYM. The maximum root yield was recorded at 8 t ha-1 of FYM, and the yield began to decline when the rate of FYM increased to 10 t ha^{-1} [6]. Regarding the use of inorganic fertilisers, the maximum yield was recorded at a Nitrogen rate of 46 kg ha-1, while a Phosphorus rate of 20 kg ha-1 produced the maximum yield [2]. Mor over an application of inorganic fertiliser rates varies from place to place, accordingly to the status of the soil, which indicates that the recommendation of fertiliser rates varies from area to area [20]

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VII. NUTRITIONAL, MEDICINAL AND ANTI-NUTRITIONAL RESEARCH

A. Nutritional Research

Nutritional composition of Anchote tubers and leaves are presented in (Table I). It was observed that there were wide ranges of variation identified for most of the biochemical characters studied [8]. Generally, biochemical analysis revealed that Anchote leaf contains higher food energy and total carbohydrates compared to Anchote tuber, which includes substantial amounts of carbohydrates, crude proteins, crude fibres, calcium, magnesium, and iron (Table I).

A higher protein content in anchote leaves and a lower content in tubers. The highest contents of magnesium (336 mg/100 g), potassium (323 mg/100 g), and calcium (313 mg/100 g) were found in the stem (Table I). Similarly, [21] reported significant variability in the nutrient composition and anti-nutrient content among 44 accessions of anchote and different parts of the plant. The leaves were found to be richer in crude protein than the tubers. In contrast, tubers were found to be superior to leaves in terms of usable carbohydrates and gross energy. The levels of anti-nutrients were found to be higher in leaves than in tubers. High total phenol and flavonoid contents were reported in anchote leaves, followed by the fruit, and the lowest in the tubers. Leaves were found to contain the highest content of saponins compared to other parts of the plant. The contribution of the amount of anchote rich in concentration of calcium content, which plays a role in the formation of a hard gel, is one of the most essential parameters highly correlated with the spread ability of Food products [28].

The mineral nutrient content of different anchote accessions varies significantly, making it essential to investigate and select accessions with better mineral nutrient content, which has a pronounced effect on the root mineral nutrient composition of anchote. According to [22], Anchote tubers contained significantly higher protein content (16.85 mg·100 g-1 dry matter basis) than the white ones. Calcium is also a recommended apatite, as it can be emanated from the high calcium and amylopectin content of its powder, which could assist in cross-linking and forming a strong network to stabilise the textural properties of jams and jellies. Jam is a popular commercial product typically made from a variety of fruits or vegetables [4]. There is also a recent initiative to promote the processing of perishable fruits into jam in Ethiopia [26].

Table I. Nutritional Composition (Mean Values) of Anchote Tubers and Leaves Per Kilogram

Proximate Composition Per Kilogram	Tubers s	Leaves
Food energy (kcal)	111.77	0
Moisture (g)	71.47	78.6
Protein (g)	2.77	5.50
Crude fat (g)	0.41	1.2
Total carbohydrate (g)	24.25	8.03
crude fiber	1.26	4.4
Ash	1.1	2.8
Mineral composition	Roots	Leaves
Calcium (mg)	117.1	303.8
Phosphorus (mg)	54.1	71.5
Iron (%)	3.5	6.7
Potassium (%)	192.1	283.3
Magnesium (ppm)	157.8	328.1
Zinc (ppm)	106.3	106
Sodium (ppm)	13.9	17.2

B. Medicinal Research

Phytochemicals are the non-nutritive bioactive compounds produced by plants through various metabolic pathways. The various phytochemical compounds commonly present in plants include steroids, terpenes, flavonoids, coumarins, alkaloids, xanthones, benzophenones, tannins, phenolic acids, saponins, anthocyanidins, reducing sugars, and glycosides, as well as antioxidant micronutrients. Various phytochemicals present in Anchote have numerous medicinal uses, which have been highlighted in this review. Many studies have shown that the presence of different phytochemicals makes plant-based foods, including fruits and vegetables, potentially excellent sources of bioactive phytochemicals [14]. Thus, for the prevention of cancer, cardiovascular diseases, diabetes, and osteoporosis, dietary guidelines for plant-based foods are formulated around the world.

C. Effects on Cardiovascular Diseases

Foods commonly associated with polyphenolic content offer antioxidant protection against free radicals and phytoalexins, which help prevent non-communicable diseases such as heart disease, inflammation, cancer, and diabetes. Flavonoids are phenolic compounds based on a C15 (C6C3C6) framework. They contain a chroman ring (C-ring) with a second aromatic ring (B-ring) at the C-2, C-3, or C-4 position. The phenolic compounds have an aromatic ring bearing one or more hydroxyl groups. Flavonoids have health benefits against oxidative stress diseases, such as Alzheimer's, arteriosclerosis, cancer, and ageing, and the concentration of iron plays a significant role in blood flow. With more red blood cells, extremities are guaranteed a healthy flow of blood and oxygen to keep those cells healthy and operating at their optimal levels [23]. Epidemiological studies have shown that carotenoids are essential in various aspects, such as serving as antioxidants and preventing agents against cardiovascular diseases.

D. Cancer

Anti-cancer activity and other health benefits provided by β-carotene include protection against cardiovascular disease and cataract prevention. β-carotene, β-cryptoxantin, and the outcomes associated with asthma and allergy. β-Carotene is ubiquitously present in green, leafy vegetables and yellow or orange fruits. The protective effects of carotenoids on bladder cancer have been reported.

E. Effect on Gastrointestinal Tract Problems

The fibre content in tapioca has been directly linked to improving several conditions within the human body, with the most notable being digestion. Fibre bulks up stool, which helps move it through the digestive tract, thereby eliminating constipation, bloating, intestinal pain, and even more serious conditions like colorectal cancer. Moreover, fibre helps to boost heart health by scraping excess cholesterol off the walls of arteries and blood vessels, thereby helping to prevent atherosclerosis and associated issues, such as heart attacks and strokes.

F. Bone and Neurological Health

Tapioca is a rich source of vitamin K, calcium and iron, all of which play essential roles in the protection and development of bones. Bone mineral density decreases with age, leading to conditions such as osteoporosis, osteoarthritis, and general weakness and reduced flexibility. If tapioca is regularly consumed, our bones can be protected, developed, and maintained as we age. The wealth of vitamin K does more than promote osteotrophic activity; it is also essential for our mental health. It has been shown that vitamin K can reduce the chances of developing alzheimer's disease by stimulating neuronal activity in the brain. Alzheimer's often occurs due to a lack of activity or mental stagnation; vitamin K helps keep neural pathways active and engaged, and free of free radicals that can cause a breakdown of brain tissue.

G. Effect on Prostate Problems and Allergies

Long-term observations on the medicinal effect of Anchote are related to prostate problems and allergies. Several decades of observations in Western European countries and a few clinical tests have shown Anchote to be effective in treating prostate problems ranging from infections and swelling to cancer. Natural antioxidants have recently become a significant area of interest, and various health advocates have recommended the increased consumption of plants rich in phenolic compounds for maintaining good health.

H. Anti-nutritional Research

Anti-nutrients are referred to as nutritional stress factors, which may either be in the form of synthetic or natural compounds that impede nutrient absorption. Anti-nutritional factors (ANFs) are considered nutritionally undesirable since they can limit the digestibility and solubility of specific nutrients, such as protein, calories, minerals, and vitamins. The commonly occurring anti-nutrients include: phytic acid, tannins, cyanides and oxalic acid

I. Phytic Acid

Phytic acid, known as inositol hexaphosphate (IP6), is the principal storage form of phosphorus in many plant tissues, especially in the grass family (wheat, rice, rye, barley, etc.) and beans. Phosphorus in this form is generally not bioavailable to humans because humans lack the digestive enzyme phytase, which is required to separate phosphorus from the phytate molecule.

In plants, phosphorus occurs mainly in two forms: phytate-phosphorus and inorganic phosphorus. Phosphorus in plants is stored in the form of phytic acid (PA), or myo-inositol 1,2,3,4,5,6-hexakisphosphate. Phytic acid accumulation occurs in plant parts. For example, when plants are grown in soil with Phytate anions, they bind to protein at a pH below the protein's isoelectric point, forming insoluble complexes and inhibiting protein digestion.

J. Tannins

Tannins are secondary compounds of high molecular weight polyphenolics with various chemical structures, widely occurring in the plant kingdom of higher plants, including many plants used as food and feed. Tannins exhibit enormous structural diversity and are systematically classified into two groups based on specific structural characteristics and chemical properties: hydrolysable tannins and condensed tannins.

Tannins that can be broken down, for example, by treatment with hot water or with tannases, are classified as hydrolysable tannins. The great variety in the structure of these compounds is due to the numerous possibilities for forming oxidative linkages.

The production of tannins appears to depend to a considerable extent on extrinsic factors, most notably soil conditions and light intensity. Their capacity to precipitate proteins varies depending on the different species, as well as the other parts of the same species, and at varying times.

K. Cyanide

Cyanoglycosides or cyanogenic glucosides (CG) are produced by about 2650 plant species, and account for approximately 90% of the broader group of plant toxins known as cyanogens. Cyanide or hydrogen cyanide (HCN) is obtained from the hydrolysis of the two CG, linamarin (93% of the total cyanide content) and lotaustralin. These two CGs can be hydrolysed to hydrocyanic acid by the endogenous enzyme linamarase, which produces acetone cyanohydrins when plant tissues are damaged and the linamarin present in the vacuole is brought into contact with this enzyme during harvesting or processing.

Cyanide has a toxic effect when converted to thiocyanate, a sulfur-containing compound, by the enzyme rhodanase after entering the bloodstream. This compound plays its toxic role by utilising body sulfur in detoxification, thereby increasing the body's demand for sulfur-containing amino acids, or by interfering with the thyroid's iodine uptake, resulting in goitre. Chronic, low-level cyanide exposure resulting from eating poorly processed high dietary cyanide sources like cassava results in the development of goitre and tropical ataxic neuropathy.

L. Oxalates

Oxalates are dicarboxylic acids that are present in plant-based foods, such as cassava, which can affect the bioavailability of magnesium and calcium. These anti-nutritional agents bind to calcium, leading to the formation of crystals or their excretion through urine. The crystals that form (calcium oxalate) majorly contribute to kidney stones. It is highly advisable to reduce oxalate intake and promote calcium intake among individuals at risk of kidney stones. Less attention had been given to the importance of oxalate levels in foods until recently, as it was believed that only 10% of the calcium excreted daily was due to dietary calcium. The impact that oxalates have on human health is highly dependent on calcium availability and the amount of oxalate consumed.

Table II. Anti-Nutrient Levels (mg/100 g) of Anchote in Wet Weight

Anti-nutrient	Level (mg/100 g)	Remark
Phylates	126.64	
Oxalates	-	
Tanins	116.31	
Cyanide	13.08	

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VIII. ANCHOTE DISEASES AND PESTS

A. Diseases of Anchote

Anchote is one of the most essential tuber and root crops, resistant to a variety of pests and diseases. Still, it is susceptible to a few diseases, including the commonly known bacterial blight and root rots.

B. Anchote Bacterial Blight

Bacterial blight is caused by a bacterium which occurs inside Anchote leaves and stems. Damage symptoms caused by bacterial blight on Anchot leaves appear as water-soaked, dead spots (lesions). The lesions arise between leaf veins and are most evident on the lower surfaces of the leaves. These angular lesions later merge into larger patches, eventually killing the leaf blade as they enlarge. The leaf blade turns brown, with a water-soaked area at the leading edge of the brown patch, which is known as leaf blighting. Severely blighted leaves wilt, die and fall, causing defoliation and shoot tip die-back or complete death of the shoot. The damage symptoms of Anchote bacteria blight are more evident in the wet season than in the dry season. The disease is more severe in young plants than in older ones. The primary source of the bacterium that causes Anchote bacterial blight is infected Anchote plants.

C. Insect Pests

There are no insects currently attacking Anchote, as the crop is drought-resistant and withstands harsh conditions, which do not provide a suitable environment for insect damage. Therefore, several researchers provided suggestions on this crop, indicating that it is the most important and beneficial for the community under study. They noted that the plant shouldn't be made to favourable conditions to prevent damage by insect pests. Coccinia abyssinica is not seriously attacked by disease and pests, but fruit decay results prematurely due to a particular kind of wasp and fruit fly effect. Some respondents mentioned a lack of seeds to collect, as cholera (Vibrio cholera) affects the mother plant, resulting in premature fruit drop. A few respondents stated that the grasshopper effect was on the seedlings. Most respondents agreed that anchote is liked by domestic animals, such as sheep, goats, and cattle. Over 50% of respondents reported that the tubers are rarely attacked by rodents, provided that other root crops are harvested early.

IX. CONCLUSION

Anchote plays a crucial role in Ethiopia, serving as a source of food, animal feed, and income for many rural and urban households. Despite its importance at the household level, Anchote production and productivity are low compared to other crops. It is mainly cultivated by small, resource-poor farmers on small-holding plots of land and used as a food security crop; however, Anchote could also be used as a source of industrial raw material for the production of starch, ethanol, bioplastics, high-quality flour, glue, and confectionery products, among others. Future research on Anchote should focus on developing eco-friendly, site-specific, and sustainable varieties for production, taking into account the maturity period of the prevailing climatic conditions in a locality. Soil fertility management of essential nutrients is of paramount importance to maximise the productivity of Anchote for the major soil types in Ethiopia. Drought management is a crucial factor in enhancing Anchote productivity, as well as designing and evaluating intercropping options and crop rotations, which are key areas that require research. There are different anti-nutritional factors (cyanide, phytate, tannin, and oxalates) in Anchote that have not yet reached a safe level of recommendation for human consumption. Therefore, anti-nutritional factor removal techniques and further methods should be investigated and introduced to process leaves and roots from the Ethiopian Anchote genotype to reach a safe level. Since existing processing technologies are inefficient and require improvement, research should focus on developing new technologies for processing that enable producers to obtain high-quality products, making them more attractive and competitive in the market. Moreover, the introduction of these root and tuber crops expanded widely into other parts of the country to address the food security problem, as well as their medicinal value, due to their attention as a future research area for relevant recommendations of control methods.

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REFERENCES

1. Abera G.and Gudeta, (2017). Response of Anchote (Coccinia abyssinica) to Organic and Inorganic Fertiliser Rates and Plant Population Density in Western Oromia, Ethiopia. *East African Journal of Science,* 1, pp. 120–126. DOI: http://dx.doi.org/10.13140/RG.2.2.22752.89605
2. Abeshu, B. (2019). "Effect of blended fertiliser (NPSB) and farmyard manure rates on yield and yield components of anchote [coccinia abyssinica (Lam.) (Cogn.)] at Jimma, Southwestern Ethiopia,"

https://repository.ju.edu.et/handle/123456789/4110

3. Adugha Mosisa Yetenayet Bekele Tarekegh Erhane and Siraw Dink Fikre Eyesus (2022). Anchote coccocinaabyssinica[LamCogn] powder, an underutilised indigenous crop, as a substitute for commercial pectin in the production of strawberry jam, 8 pp.1-10. DOI: https://doi.org/10.1016/j.heliyon.2022.e10700
4. Awulachew, M.T.,(2021). A current perspective on jam production, *Advanced Nutrition Food Science,*6(1). DOI: http://dx.doi.org/10.33140/ANFS.06.01.01
5. Ayalew, Y. (2016). Nutritional and Phytochemical Evaluation of Anchote (Coccinia abyssinica) (Lam.) (Cogn.) Accessions to Promote its Contribution to Food Security and Medicinal Use. PhD Dissertation in Food Science and Nutrition, Addis Ababa University. DOI: https://doi.org/10.11648/j.aff.20231204.15
6. Baghel, S.S., Bose, U.S. and Singh, S.S. (2017). Impact of Different Organic and Inorganic Fertilisers on Sustainable Production of Bottle Gourd [Lagenaria siceraria L.]. *International Journal of Pure and Applied Bio Science* 5(2), pp. 1089-1094. https://www.ijpab.com/form/2017%20Volume%205,%20issue%202/IJPAB-2017-5-2-1089-1094.pdf
7. Bekele, ST. (2017). Morphological and Molecular Genetic Diversity and Cytogenetics of Cultivated Anchote (Coccinia abyssinica (Lam.) Cogn) from Ethiopia (Doctoral dissertation, Addis Ababa University). http://thesisbank.jhia.ac.ke/id/eprint/5154
8. Bikila, A.M., Y., Esho, T.B., Forsaido, S.F. (2020).Effect of predrying treatment and drying temperature on proximate composition, mineral contents, thermophysical properties of anchote(cocosine abyssinica(Lam)flour *Food science nutrition* (8)(10), pp. 5532-5544. DOI: http://dx.doi.org/10.1002/fsn3.1860
9. Biratu, A., Derbew. And Bdesta, F. (2019). Effect of blended fertiliser (nps) and farm yard manure rates on yield and yield components of anchote {[coccinia abyssinica(Lam.) (cog)] at Jimma, Southwestern Ethiopia. *Jimma University Open Access Institutional Repository*. https://repository.ju.edu.et/bitstream/handle/123456789/4378/Biratu%20final%20Thesis.pdf?sequence=1&isAllowed=y
10. Duresso M.E. (2018). Study on ethnobotany and phenotypic diversity in anchote (Coccinia abyssinica (Lam.) Cogn.) landraces in Western Ethiopia. *International Journal of Agricultural Sciences* 8:pp.1404-1427. https://sciendo.com/es/article/10.2478/johr-2020-0023?tab=references
11. Gudeta A. (2022) Production Status and Relevance of Anchote (Coccinia Abyssinica (Lam.) in Ethiopia: A Review, *International Journal of Agricultural Extension and Rural Development Studies*, Vol 9, No.4, pp.20-27 https://eajournals.org/ijaerds/vol-9-issue-4-2022/production-status-and-relevance-of-anchote-coccinia-abyssinica-lam-in-ethiopia-a-review/
12. G. Fitsum, M. Gebremichael, and H. Gebremedhin (2020). “Flower bud removal and earthing up time increased growth and tuber yield of potato at eastern Tigray, Ethiopia,” Indonesian Journal of Agricultural Science, vol. 20, no. 2, pp. 77-85. DOI: http://dx.doi.org/10.21082/ijas.v20n2.2019.p77-85
13. Habte wakjera weyessa Gardew Amalu Nebiu and Garome shifaraw. (2024). Effect of Earthing up frequency on Growth and yield of Anchote (coccessia abyssinica) varieties at Gimbi District, Western Ethiopia, *International Journal of Agronomy*, pp. 1-13. DOI: http://dx.doi.org/10.1155/2024/3918033
14. Haki.,G., (2019).“Phytochemical constituents in edible parts of anchote (Coccessia abyssinica(Lam)(Cogn)I Accessions from Ethiopia, ” Botswana Journal of Agriculture and Applied Sciences, vol.13, no.1, pp.1–9. DOI: http://dx.doi.org/10.37106/bojaas.2019.16
15. Legesse A (2022). Genetic erosion of anchote (Coccinia abyssinica) in Ethiopia: a Review. *J. Agri. Res. Adv.*, 04(03): pp.20-27. https://jara.org.in/archive/genetic-erossion-of-anchote-coccinia-abyssinica-in-ethiopia-a-review
16. Mekbib, Y. and Deressa, T. (2016). Exploration and collection of root and tuber crops in East Wollega and Ilu Ababora Zones: rescuing declining genetic resources. *Indian Journal of Traditional Knowledge,* 15 (1), pp. 86-92 https://www.eajournals.org/
17. Meseret E.D. (2018).Study on ethnobotany and phenotypic diversity in anchote (Coccinia abyssinica (Lam.) Cogn.) Landraces in Western Ethiopia. *Journal of Agricultural and Food Chemistry* (8):2, pp.1402-1427. https://www.researchgate.net/profile/Negash_Ayana/publication/331548187_Anchote_Coccinia_abyssinica_Lam_Cogn_A_nutrient_rich_root_tuber_crop_of_Ethiopia/links/5c7fc0a192851c69505a7cd4/Anchote-Coccinia-abyssinica-Lam-Cogn-A-nutrient-rich-root-tuber-crop-of-Ethiopia.pdf
18. Mossa H.Y., Mohammed A., and Fekadu D. (2018). Effect of flower bud removal on root quality of anchote (Coccinia abyssinica (Lam.) Cogn.) accessions at Bishoftu, Ethiopia. *Asian Journal of Plant Science and Research* 8(4), pp. 18–23 https://www.researchgate.net/profile/Seid-Muhie/publication/301834003_Effect_of_Flower_Bud_Removal_on_Growth_and_Yield_of_Anchote_Root_Coccinia_abyssinica_Lam_Cogn_Accessions_at_Bishoftu/links/5729f83708aef7c7e2c4eaed/Effect-of-Flower-Bud-Removal-on-Growth-and-Yield-of-Anchote-Root-Coccinia-abyssinica-Lam-Cogn-Accessions-at-Bishoftu.pdf
19. .Mulualem, T. (2017). Genetic Diversity, Path Coefficient Analysis, Classification and Evaluation of Yams (Dioscorea spp.) in Southwest Ethiopia. PhD dissertation, Haramaya University, Ethiopia https://www.revista.ccba.uady.mx/ojs/index.php/TSA/article/view/378/436
20. Negash G. (2019). Anchote (Coccinia abyssinica (Lam.) Cogn.): A nutrient-rich root tuber crop of Ethiopia. *Agricultural Science Research Journal,* (9), pp.1-11. https://www.longdom.org/open-access-pdfs/agronomy-practices-of-anchote-coccina-abyssinca-l-in-ethiopia-a-review.pdf
21. Nissa,,c, Aritan,P., Febrianto,R.,, Aditiya, W., Hay, L. (2019). Effect of Sugar on Nutrient composition and shelf life of Red Guava James: Effect of sugar on nutrient and shelf life. https://www.proquest.com/docview/2558296083?pq-origsite=primo&searchKeywords=aroma+rico
22. Parmar, A., Gebre, B.A., Legesse ,A., Demelash, Y., Fladung, K., Hensel, O. (2017). Nutritional comparison of white and red Coccinia abyssinica (Lam.) Cogn. Accessions: An under-utilised edible tuber of the Ethiopian Highlands. Foods 6(8); pp.71. DOI: https://doi.org/10.3390/foods6080071
23. Regasa, M.B., Fayisa K.G., and Woldegebriel, H.H. (2018). Bioactive phytochemical screening and antioxidant potential of different solvent extracts of anchote: the underutilised delicious cultural food of Oromo People, Ethiopia. *Food Science and Technology* 6(4), pp. 81–90. DOI: http://dx.doi.org/10.13189/fst.2018.060402
24. Sadhan, K. R. and Dipa, R. (2016). Utilisation of Medicinal Plants and Their Vulnerability to Climate Change in the Northern Region of Bangladesh. *American Journal of Plant Sciences*, 7, pp. 1782-1793. DOI: http://dx.doi.org/10.4236/ajps.2016.71316681
25. Safawo T., Sandeep B.V., Pola S., Tadesse A. (2018). Synthesis and characterisation of zinc oxide nanoparticles using tuber extract of anchote (Coccinia abyssinica (Lam.) Cong..) for antimicrobial and antioxidant activity assessment. OpenNano 3, pp. 56–63. https://www.sciencedirect.com/science/article/pii/S2352952018300306
26. Tadele, B., Abera, S., Dereje, B., (2022). Optimization of ingredients level for developing yellow passion(Passiflora edulis) jam *International journal of Fruit Science* 22(1), p.p 183- 202 https://www.tandfonline.com/doi/full/10.1080/15538362.2022.2025515
27. Teferi, Z. and Chewaka, M. (2023). Evaluation of underutilised cultivated Anchote (Coccinia abyssinica (Lam.) Cogn.) accessions in West Shewa Zone, Oromia Regional State, Central Ethiopia—Daagu *International Journal of Basic*. DOI: https://doi.org/10.20372/DIJBAR.20076.
28. 28.Tifari, K.t., Nugrobo, I.p.E., Purwanti, N., (2018). Physicochemical and sensorial properties of durian am prepared from Fresh and frozen pulp of various durian cultivars. International Food Research Journal, 25(2), pp. 825-834. https://www.researchgate.net/publication/325593741_Physicochemical_and_sensorial_properties_of_durian_jam_prepared_from_fresh_and_frozen_pulp_of_various_durian_cultivars
29. Tileye ,(2020). Coccinia Abyssinica(Lam.) Cogn. (Anchote) Biology, Productivity, and Prospects of Genetic Improvement Using Biotechnological Tools. *Journal of Horticultural Research* 2020, vol. 28(2), pp. 1–10. DOI: http://dx.doi.org/10.2478/johr-2020-0023
30. Tolera, S. B. (2017). Morphological and Molecular Genetic Diversity and Cytogenetics of Cultivated Anchote (Coccinia abyssinica (Lam.) Cogn) from Ethiopia. PhD Dissertation, Department of Microbial, Cellular and Molecular Biology, Addis Ababa University. http://thesisbank.jhia.ac.ke/id/eprint/5154
31. Tufa, A., Geleta, N. and Legesse, H. (2017). Preliminary Study for Production of Anchote (Coccinia abyssinica (Lam.) Cogn.) in the Western Part of Ethiopia. *J. Agric. Food Nat. Resour.,* 1(1): 16-20.https://pubmed.ncbi.nlm.nih.gov/1346173/
32. Wayessa, B.S. (2018). Anchote (Coccinia abyssinica): A tuber viewed as a relative of women in the Wallaga Region of southwestern Ethiopia. *Ethnoarchaeology* 10(1), pp.34–55.

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