

Review on the Production Constraints of Locally Cultivated Pumpkin (*Cucurbita spp.*) in Kenya

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Abstract

Cucurbita, commonly known as pumpkins, are a group of versatile and economically significant plants cultivated worldwide. In Kenya, pumpkins play a crucial role in the agricultural sector due to their versatility, serving a wide range of purposes, including food consumption, medicinal applications, and livestock feed. However, the cultivation of pumpkins in the country faces various challenges, impacting productivity and limiting its potential for growth. The purpose of this review was to explore the challenges encountered by Kenyan farmers in pumpkin production. A comprehensive understanding of these constraints is essential for formulating effective strategies to enhance pumpkin cultivation and uplift the livelihoods of farmers in the area. Extensive searches were performed on Scopus, Web of Science, and Google Scholar to gather scientific articles, technical reports, and government documents related to *Cucurbita* in Kenya. Pumpkin (*Cucurbita spp.*) production in Kenya faces numerous constraints, including disease, pests, negative connotations towards pumpkins, unpredictable weather conditions, modern civilization, chlorosis, development of small, unmarketable, and low-priced fruits, fruit rotting, fruit and flower abortion, a lack of genetic variation, post-harvest losses and high transport costs. Limited research exists on challenges faced by pumpkin farmers outside of Central and Western Kenya. The study recommends conducting more extensive research, including diverse agro-ecological zones like Eastern, Rift Valley, Coastal, and Northern regions, to gain a holistic understanding of production constraints throughout the country. The study further suggests promoting research on disease and pest management, raising awareness to overcome negative perceptions, improving market access and infrastructure, facilitating knowledge transfer, and creating value addition opportunities for pumpkin products. Implementing these recommendations will sustain pumpkin production and maximize benefits for Kenyan farmers and consumers.

Keywords: Pumpkin, *Cucurbita spp.*, production constraints, Kenya, smallholder farmers, agriculture, food security, market opportunities

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Introduction

Pumpkins, known as *Cucurbita*, are members of the Cucurbitaceae family which also includes gourds, melons, squash, courgettes and cucumber,

celebrated for their distinctive appearance, versatility, and various uses (Ayyildiz et al., 2019; Kaur et al., 2020; Rolnik & Olas, 2020). The etymology of the term

"pumpkin" can be traced back to its Greek origin, specifically derived from the word "pepon," denoting a "large melon." The term "Pepon" underwent a transformation by the French language, resulting in its alteration to "pompon." The term "pompon" underwent a modification by the English language, resulting in the adoption of the term "Pumpion." The American colonists transformed the term "pumpion" into the word "pumpkin." (Al-Shami, 2013; Adebayo et al., 2013; Devine, 1980). While originally indigenous to Northern Mexico and parts of United States, pumpkin-related seeds dating back to 7000 to 5500 BC were discovered in Mexico (Gohari et al., 2011). Over time, pumpkins have spread across the world and integrated themselves into various cuisines and cultural practices (Paris, 2017). From pumpkin curries in India to pumpkin soup in Europe and Africa, these adaptable fruits have become essential components of culinary customs globally.

The Cucurbita genus consists of approximately 20 to 27 different species, as mentioned in studies by Esquinas-Alcazar and Gulick (1983) and Whitaker & Bemis (1975). Nevertheless, the three most commonly grown species worldwide are *Cucurbita maxima*, *Cucurbita moschata*, and *Cucurbita pepo*, according to Yoo et al. (2023). These species exhibit significant differences in their physical characteristics, genetic makeup, and ability to thrive in diverse agro-ecological regions, including tropical and subtropical zones, arid deserts, as well as temperate climates (Rai et al., 2008; Khairi et al., 2014; Paris, 2017). They also exhibit different growth habits, with some being vine types that can reach up to 15 meters in length, while others are bush types with shorter vines (Aruah et al., 2010). The leaves of Cucurbita landraces, representing local varieties, demonstrate a wide array of diversity in terms of their size, shape, color, hairiness, and texture (Nodoro et al., 2007). Similarly, the flowers of Cucurbita landraces exhibit significant variability in terms of color, size, and shape (Aruah et al., 2010). The shape, size, and color of fruits and seeds among various *cucurbita* species exhibit a remarkable degree of diversity (Balkaya et al., 2010).

Research examining the nutritional composition of pumpkins indicates that they contain a diverse array of nutrients essential for human health (Ahmad & Khan, 2019; Batool et al., 2022; El Khatib & Muhieddine, 2020). Different parts of the pumpkin plant, including the flesh, leaves, and seeds, provide varying nutritional advantages, as they are abundant sources of oils, proteins, carbohydrates,

minerals, and specific phytochemical compounds (Rolnik & Olan, 2020; Hussain et al., 2022). Furthermore, pumpkins offer numerous health benefits, such as possessing anti-carcinogenic properties, antioxidant capabilities, anti-inflammatory effects, anti-diabetic potential, and the ability to inhibit kidney stone formation (Batool et al., 2022; Khorolskaya, 2023; de Oliveira et al., 2013; Teeranachaideekul, et al., 2022).

In Kenya, pumpkins play a vital role in bolstering food security as they offer a drought-resistant crop option that is rich in nutritional value. However, its potential remains unexploited (Karanja et al., 2013; Isutsa & Kiramana, 2017; Kiramana & Isutsa, 2019; Ndengwa et al., 2016). Several factors have contributed to this underutilization and understanding the production constraints faced by farmers in Kenya is crucial for developing effective strategies to improve pumpkin production, ensure food security, and enhance the livelihoods of smallholder farmers. The review provides valuable insights that can guide policymakers, researchers, and agricultural stakeholders in devising measures to foster sustainable pumpkin cultivation and utilization in Kenya.

Methodology

The literature review began by identifying key search terms related to the topic, such as "pumpkin cultivation in Kenya," "Cucurbita species," "agricultural constraints," "smallholder farmers," and "production challenges". These keywords were used to search various academic databases, including PubMed, Web of Science, and Google Scholar. The initial search yielded a considerable number of articles and publications related to pumpkin cultivation, but many were not specific to Kenya. To narrow down the search results, filters were applied to include only studies conducted in Kenya. Articles were evaluated based on their relevance to the research topic. Publications with a primary emphasis on agronomic practices, pest and disease management, climate impact, resource availability, technology adoption, market dynamics, and socio-economic factors affecting pumpkin farming in Kenya were collated. Papers that lacked sufficient data or were unrelated to the research topic were excluded. The selected articles were reviewed thoroughly to extract relevant information, key findings, methodologies, and conclusions from each article were noted.

Nutritional benefits of Pumpkins

In general, pumpkins hold significant nutritional and medicinal importance (El Khatib & Muhieddine, 2020); Matin et al., 2022; Ibrahim et al., 2021). Various researchers have found that pumpkins have a diverse array of essential nutrients. Carbohydrates, which are a primary source of energy, are found abundantly in pumpkins (Habib et al., 2015). In a study conducted by Karanja et al. (2014), they investigated the nutritional composition of *Cucurbita maxima* varieties from various regions in Kenya. The results revealed that the seeds of *Cucurbita maxima* varieties contained varying amounts of carbohydrates (ranging from 8.66% to 27.35%). However, these values can vary depending on the pumpkin's origin, the soil and climate conditions during growth, and the pumpkin variety analyzed (Hagos et al., 2023). Pumpkin seeds, being storage parts of the plant, have higher nutrient content than the fruit flesh (Raihana et al., 2015; Mansour et al., 1993; Dhiman et al., 2009). Additionally, pumpkins are known to contain fatty acids, including monounsaturated fatty acids, which have been studied by Lestari and Meiyanto (2018) and Veronezi and Jorge (2015). Proteins, crucial for muscle development and repair, are also present in pumpkins, as highlighted by Patel (2013), Rezig et al. (2013), and Kulaitienė et al. (2014). Furthermore, pumpkins offer an assortment of health-promoting compounds. Among these are polyunsaturated carotenoids, which have been investigated by Kulczyński and Gramza-Michałowska (2019), Provesi and Amante (2015), and Hussain et al. (2021). These compounds are beneficial antioxidants that contribute to overall well-being. Pumpkins are also a source of tocopherols, which are important for protecting cells from oxidative damage (Rezig et al., 2012).

Pumpkins also contain magnesium, phosphorus, calcium manganese, copper, and zinc as essential elements (Batoool et al., 2022). These elements play crucial roles in various physiological functions, such as bone health, enzyme activities, and immune system support. Moreover, the nutritional value of pumpkins extends to include tryptophan, an amino acid essential for serotonin production, which can influence mood and well-being (Yang et al., 2019). Additionally, delta-7-sterols, studied by Kumari et al. (2020), are a type of phytosterol present in pumpkins, known for their potential cholesterol-lowering properties. Considering this wealth of nutrients, pumpkins emerge as a valuable addition to the diet,

offering a wide range of health benefits. Their nutritional profile makes them not only a popular culinary choice but also an important resource for promoting overall health and wellness. Incorporating pumpkins into regular dietary intake can contribute to a balanced and nutritious diet.

Health benefits of Pumpkins

Pumpkin also offers a wide array of health benefits, with research suggesting its potential in various therapeutic areas. Several studies, including those by Yadav et al. (2010) and Lee et al. (2015), have highlighted the notable anti-carcinogenic properties of pumpkin. Other researchers have discovered that pumpkin seeds exhibit a DHEA-blocking action, which is essential in preventing prostate cancer (Dotto & Chacha, 2020; Gossell-Williams et al., 2006). Additionally, pumpkins have been found to possess antioxidant capabilities, as highlighted by research conducted by Dini et al. (2013) and Chen & Huang (2019). Flavonoids are polyphenolic compound fractions in foods and are anti-oxidant and anti-cancer (Tiwari and Husain, 2017). In addition, pumpkin exhibits anti-microbial potential, as studied by Nadjiba et al. (2018) and Muruganatham et al. (2016). This suggests that pumpkin's bioactive compounds may help combat certain harmful microorganisms and support the body's immune system. The diverse range of health benefits attributed to pumpkin highlights its potential as a valuable functional food. Besides anti-inflammatory benefits, they also help reduce arterial cholesterol bringing down susceptibility to stroke and heart attack (Asgary et al., 2018). The anti-diabetic potential of pumpkin has been explored by Adams et al. (2011), Ceclu et al. (2020), and Sedigheh et al. (2011). Their studies suggest that pumpkin may aid in managing blood sugar levels and improving insulin sensitivity, which are crucial factors for diabetes management. Woldesenbent (2020) reported that pumpkin may have inhibitory effects on kidney stone formation, potentially reducing the risk of kidney stone development. Pumpkin seeds are said to treat kidney stones (Agrawal & Shahani, 2021); this may be due to the high phosphorus level. Furthermore, pumpkins have shown hypotensive (blood pressure-lowering), anti-inflammatory, and blood coagulatory effects, as indicated by studies mentioned by Woldesenbent (2020). These properties may have implications for cardiovascular health, reducing inflammation, and supporting healthy blood clotting processes. The unsaturated fatty acids in pumpkin oils

enhance the maintenance of healthy blood vessels, nerves, and tissues (Djuricic & Calder, 2021). Pumpkins are also reported to reduce the risk of muscular degeneration, a serious eye problem usually resulting in blindness (Kulaitienė et al., 2014; Provesi & Amante, (2015). The large amounts of zinc are an essential immune booster and bone density improvement (Fallon, 2005). Expressed pumpkin oil is documented to be helpful in the management of rheumatoid arthritis (Al-Okbi et al., 2017).

Production constrains of locally cultivated pumpkins in Kenya

Pumpkin (*Cucurbita spp.*) is an essential crop grown in Kenya, contributing significantly to food security and income generation for smallholder farmers. However, pumpkin production in the country faces various constraints that impact productivity and hinder its full potential. Diseases can cause severe detrimental effects on pumpkin crops, resulting in significant decreases in yield and economic losses for farmers. In their research conducted in Nyeri and Kakamega, Isutsa & Kiramana (2017) observed that blights and mildews were among the diseases that adversely affected pumpkins in the region. Blights and mildews are common fungal diseases that can rapidly spread in warm and humid conditions, leading to defoliation and reduced photosynthetic capacity, ultimately affecting pumpkin yield and quality. Similarly, Peter (2011) found that diseases were the primary constraints in pumpkin production in Central and Eastern Kenya. The most frequently reported diseases affecting *Cucurbita spp.* were fungal, bacterial, and viral diseases, as also documented in a study conducted in Uganda by Masika et al. (2022). Diseases, especially blights and mildews, pose substantial challenges to pumpkin cultivation in Kenya and neighboring countries. Addressing these diseases through integrated pest and disease management practices, disease-resistant varieties, and early detection methods is crucial for sustainable pumpkin production and ensuring food security for farmers and communities in the region.

Pumpkin production in Kenya also faces significant challenges due to the presence of various pests that cause extensive damage to crops, resulting in reduced yields and economic losses for farmers. The detrimental impact of pests on pumpkin cultivation is well-documented in multiple studies, including those conducted by Isutsa & Kiramana (2017), Farmers Trends (2022), and Masika et al. (2022). The common pests affecting pumpkin cultivation in the region include a diverse range of

organisms, such as wasps, fruit flies, leaf rollers, rats, porcupines, moles, aphids, thrips, and whiteflies. Each of these pests poses a unique threat to pumpkin plants, targeting different parts of the crop and causing various types of damage. In Nyeri, the prevalence of fruit rotting was attributed to the presence of wasps and fruit flies (Isutsa & Kiramana, 2017). These insects can lay their eggs in pumpkin fruits, leading to rot and rendering them unmarketable. Such damage can have severe implications for farmers, as it not only results in a direct loss of the affected fruit but can also reduce the overall quality and marketability of the pumpkin harvest. Whiteflies, aphids, and rats were identified as the most important pest constraints in pumpkin fields in the neighbouring country Uganda (Masika et al., 2022). The most important cucurbit production constraints reported include arthropod and rodent pests, diseases, and weeds (Aruah *et al.*, 2010). Arthropod and rodent pests and diseases may cause direct damage or create opportunities for secondary effects that provide suitable breeding grounds for lepidopterans, hemipterans, dipterans, coleopterans, and homopterans (Aruah et al., 2010). The cumulative impact of these pests leads to extensive crop damage, reducing the overall yield potential of pumpkin fields and inflicting economic losses on farmers. Without effective pest management strategies, pumpkin production in Kenya remains vulnerable to the destructive effects of these pests.

Other constraints reported in the studies include: poor yields, flower abortion, traditional beliefs, modern civilization, inadequate utilization knowledge, seed unavailability, poor market prices, exploitation by brokers, post-harvest losses, inadequate market information, low consumer awareness, low demand, over-ripening of fruits, high transport costs, fruit rotting, chlorosis, browning, and leaf death (Isutsa & Kiramana, 2017). Peter (2011) identified insufficient rainfall, farmers' preference for maize and beans, and negative connotations towards pumpkins as limiting factors. Additionally, pumpkin cultivation faces challenges like Nyawira (2019) pointed out that one of the challenges of growing pumpkins is the space they require due to their creeping vines, necessitating large land sizes. Nyabera et al. (2021) attributed the lack of genetic variation and pumpkin distribution in western Kenya to monocropping and intercropping farming systems, as well as local seed exchange practices rather than geographical and climatic differences. Kiharason & Isutsa (2019) reported that pumpkin fruit sale is not

very popular in the study area, particularly among urban dwellers who have limited access to the fruit besides the market. Therefore, they emphasized the need for pumpkin fruit value addition options to be made available in the markets to provide more convenient foods preferred by urban consumers.

Conclusion and recommendation

Pumpkin production in Kenya faces numerous constraints, including disease, pests, negative connotations towards pumpkins, unpredictable weather conditions, modern civilization, chlorosis, development of small, unmarketable, and low-priced fruits, fruit rotting, fruit and flower abortion, poor market prices, lack of genetic variation, post-harvest losses and high transport costs. Limited information is available regarding the challenges faced by farmers during pumpkin cultivation in regions other than Central and Western Kenya, as most of the existing studies have primarily concentrated on these specific areas.

To gain a comprehensive understanding of the challenges encountered by pumpkin farmers across various regions in Kenya, it is recommended to conduct more extensive research that encompasses a broader geographic scope. Researchers should extend their investigations to include different agro-ecological zones in Kenya, such as Eastern, Rift Valley, Coastal, and Northern regions. This approach will provide a more holistic view of the diverse production constraints faced by farmers throughout the country. Other comprehensive strategies needed to improve pumpkins production in Kenya includes research on disease and pest management, awareness campaigns to change negative perceptions, improving market access and infrastructure, enhancing knowledge transfer, and developing value addition options for pumpkin products. Additionally, diversification of farming practices, intercropping, and enhancing genetic diversity can contribute to better pumpkin cultivation and utilization across different regions in Kenya.

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