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Research

ASSESSMENT OF ESSENTIAL MINERALS IN COWPEA AND FENUGREEK SEEDS AND THEIR DIETARY SIGNIFICANCE

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Abstract:

Cowpea (Vigna unguiculata) and fenugreek (Trigonella foenum-graecum) grow well in dry, nutrient-poor soils in Africa and Asia. Cowpeas are a good source of protein, fiber, and vitamins. Fenugreek is used in cooking and medicine. These seeds have iron, calcium, magnesium, and potassium in them, which are good for your bones and immune system. Cowpeas boil away nitrates, but fenugreek keeps them. Fenugreek takes away nitrogen, but cooked cowpeas add protein. The two beans' potassium, calcium, and nutritional bioavailability change depending on how they are cooked. When raising and eating food for the safety of the community, these effects must be considered. Cowpea is a good source of protein and fiber in dry areas, and fenugreek is used in both cooking and medicinal. The seeds of both plants that don't have endosperms fix nitrogen in cotyledon soil. Studies on nutrition suggest that cooking cowpeas lowers nitrates and raises levels of nitrogen, calcium, magnesium, and potassium. But fenugreek cooks in a different way. To make sure that everyone has enough food, we need to enhance the way we prepare food so that it is safe and healthy.

Keywords: *Vigna unguiculata*, *Trigonella foenum-graecum*, Mineral composition, Trace minerals, Sustainable agriculture

Introduction

Plant reproduction, survival, and species survival depend on seeds. Plant embryos and nutrients are stored for germination and seedling growth. Botany, agriculture, and food science study legume seeds for their nutritional and agricultural benefits (Bewley, Bradford, Hilhorst, & Nonogaki, 2013). Worldwide, cowpea (Vigna unguiculata) and fenugreek (Trigonella foenum-graecum) are significant legumes.

Cowpea, also known as black-eyed pea or lobia, is a key pulse crop growing in tropical and subtropical regions, mainly Africa and Asia (Timko & Singh, 2008). Kidney-shaped, eye-spotted seeds are white, brown, red, or black. Non-endospermic cowpea seeds store nutrients in the cotyledons. Proteins, carbohydrates, vitamins, and minerals make these seeds a valuable food source (Boukar et al., 2018). Cowpeas fix nitrogen and provide nutrition for sustainable agriculture (FAO, 2012).

Cowpea seeds are cattle fodder and pulses in many cuisines.

South Asian, Middle Eastern, and Mediterranean leguminous herb fenugreek (Trigonella foenum-graecum) is valuable. Due to its flavor and smell, small, firm, yellowish-brown fenugreek seeds are used as a spice (Srinivasan, 2006). Fenugreek seeds, like cowpea, are non-endospermic and have two cotyledons that store nutrients for germination. These seeds contain proteins, essential oils, alkaloids, and mucilage (Basch, Ulbricht, Kuo, Szapary, & Smith, 2003). Fenugreek is used in cuisine and medicinal. The seeds improve metabolism, digestion, and blood sugar management (Srinivasan, 2006). Many dishes use fenugreek leaves as a vegetable.

Cowpea and fenugreek seeds have a lot in common because they are both Fabaceae. A plumule and a radicle make up the embryos of dicotyledonous seeds. During germination, the cotyledons of both seeds feed the embryo (Bewley et al., 2013). The seeds were the same, but they were different sizes, shapes, textures, and uses in business. Cowpea seeds are bigger and are used as animal feed and pulses. Fenugreek seeds are used as spices and medicinal.

Cowpea farming is important in areas with poor soil and little rain. The drought-tolerant crop grows well in less-than-ideal areas, making sure that people in poor countries have enough food (Timko & Singh, 2008). Fenugreek is both a spice and a medicine. The seeds give South Asian food its taste and smell (Srinivasan, 2006). Both crops can be used in many ways and are essential in agriculture around the world. It is crucial to understand the minerals in these seeds. Minerals are important for many things in the body. They help with metabolism, neuron function, bone growth, and the immune system (Soetan, Olaiya, & Oyewole, 2010). Calcium, phosphorus, magnesium, potassium, sodium, and trace elements including iron, zinc, copper, and manganese are all found in fenugreek and cowpea seeds. Cowpea seeds stop anemia, and fenugreek seeds provide you calcium and help your bones grow (Boukar et al., 2018; Basch, 2003).

Soil, environment, and farming practices affect seed mineral content. Cowpea and fenugreek seeds must be tested for minerals to see how healthy they are and how good they are for you. These research can assist farmers pick crops that are high in nutrients and make farming better (FAO, 2012).

Lastly, cowpea and fenugreek seeds are good for you, for eating, for farming, and for your health. Similar seed forms signify that they come from the same family, whereas different shapes suggest that they have different uses and are important for the economy. Knowing how minerals, structure, and composition work together helps with nutrition, sustainable farming, and food security.

Material method:

The researchers collected fenugreek (Trigonella foenum-graecum) and cowpea (Vigna unguiculata) seeds for their investigation. The obtained sample fruits were cleaned with water to get rid of any surface impurities before being rinsed with distilled water. The samples were allowed to dry at room temperature before being dried in an oven. Before being turned into grits, the dry materials were ground into a fine powder using a mortar and pestle. Following acid digestion, the sample was labeled A, B, C, and D and put in a sealed plastic container. The Kasturi Agrotech

Mineral Analysis Laboratory in Sangli was used to test for minerals.

Literature Review:

Cowpea and fenugreek are significant leguminous crops recognized for their nutritional value, health advantages, and contribution to sustainable agriculture. Cowpea (Vigna unguiculata), also referred to as black-eyed pea, has been farmed for generations in Africa and serves as a staple crop in numerous Sub-Saharan nations. It is esteemed for its capacity to thrive in arid and nutrient-deficient soils, rendering it appropriate for sustainable agricultural systems (Jayathilake et al., 2018). Cowpea is nutritionally abundant in protein, dietary fiber, vitamins, and vital minerals, including iron and magnesium. Research demonstrates that cowpea has approximately 22–25% protein and 5–6% dietary fiber, establishing it as a significant plant-based protein source, especially in areas with restricted access to animal protein (Kaur et al., 2018).

Fenugreek (Trigonella foenum-graecum) is a significant legume utilized as both a culinary spice and a medicinal herb, especially in Mediterranean, Middle Eastern, and Asian regions. The seeds and leaves are ingested for their nutritional and medicinal benefits. Fenugreek is abundant in proteins, soluble fiber, and essential minerals including iron and magnesium. Olaiya and Soetan (2014) assert that fenugreek enhances digestion and regulates blood glucose levels. Furthermore, the seeds encompass bioactive substances like saponins, alkaloids, and flavonoids, which confer antioxidant and anti-inflammatory properties (Faisal et al., 2024).

Cowpea and fenugreek are both vital to sustainable agriculture. Cowpea enhances soil fertility via nitrogen fixation and is frequently utilized in crop rotation systems to increase soil health and productivity (Ishola & Aramide, 2022). Fenugreek enhances soil quality by improving soil structure and moisture retention (Legesse et al., 2020). Additionally, these crops promote biodiversity and diminish reliance on synthetic fertilizers and pesticides.

The literature indicates that cowpea and fenugreek are nutritionally abundant, environmentally sustainable, and commercially advantageous crops. Their elevated protein content, therapeutic attributes, and agricultural benefits render them crucial elements of food security and sustainable agriculture systems globally.

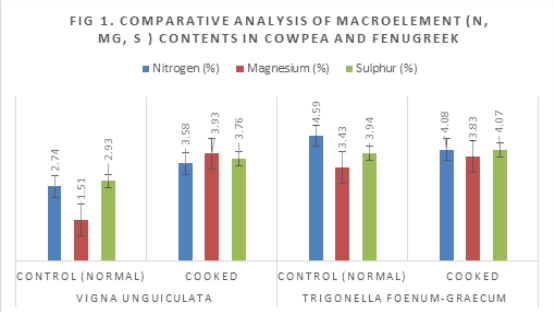
Result and Discussion:

Cowpea (*Vigna unguiculata*) and fenugreek (*Trigonella foenum-graecum*) seeds are both important sources of nutrients. They are widely consumed in various diets and have different mineral compositions that provide various health benefits. This section will analyze and compare the mineral content of cowpea and fenugreek seeds, highlighting how these differences can inform dietary choices and agricultural practices.

The nutritional attributes of two leguminous crops, Vigna unguiculata (cowpea) and Trigonella foenum-graecum (fenugreek), are presented in the table under two distinct conditions: raw (control) and cooked. Essential nutrients and minerals measured include nitrate, nitrogen, phosphorus, sodium, potassium, calcium, magnesium, sulfur, boron, zinc, iron, copper, manganese, molybdenum, ash content, and moisture percentage.

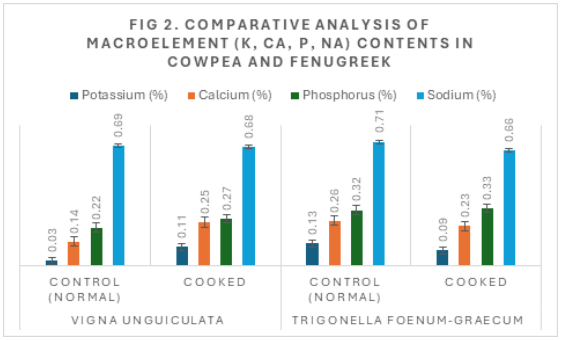
The nutritional attributes of two leguminous crops, Vigna unguiculata (cowpea) and Trigonella foenum-graecum (fenugreek), were analyzed under raw and cooked conditions. Important nutrients and

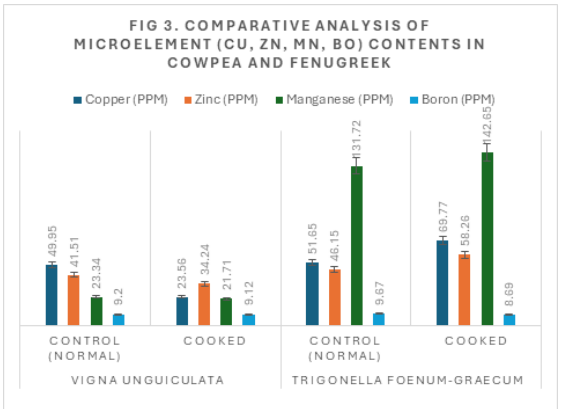
minerals such as nitrate, nitrogen, phosphorus, sodium, potassium, calcium, magnesium, sulfur, boron, zinc, iron, copper, manganese, molybdenum, ash content, and moisture were evaluated. Previous studies have shown that cooking and other processing methods significantly influence the nutritional quality and mineral composition of legumes (Deshpande, 1992; Mudryj et al., 2014; Tharanathan & Mahadevamma, 2003).



A significant reduction in nitrate content was observed in cowpea, which decreased from 44.90 PPM in its raw state to 21.84 PPM following cooking. This finding suggests that cooking may substantially diminish nitrate levels, which is advantageous for health. Conversely, fenugreek exhibited a higher initial nitrate concentration of 146.03 PPM, which decreased to 97.08 PPM post-cooking. This indicates that, although heating reduces nitrate levels, fenugreek retains a higher concentration compared to cowpea. A substantial reduction in nitrate content was observed in cowpea after cooking. Similar decreases in nitrate and anti-nutritional factors due to thermal processing have been reported in several legumes (Kumar et al., 2017; Sreerama et al., 2012). Fenugreek also showed a reduction in nitrate levels after cooking, although its nitrate concentration remained higher than that of cowpea (Acharya et al., 2006; Sharma et al., 2014).

The nitrogen concentration in cowpea increased from 2.74% in its raw form to 3.58% after cooking, suggesting that heating may enhance protein availability. In contrast, fenugreek demonstrated a decline in nitrogen concentration from 4.59% to 4.08%, indicating that boiling may variably affect the protein composition of these legumes. Nitrogen concentration increased in cooked cowpea, suggesting improved protein availability after heat processing. Similar observations were reported by Mubarak (2005) and Khalil and Mansour (1995), who noted that cooking improves protein digestibility in legumes. In contrast, fenugreek showed a slight decrease in nitrogen content after boiling, possibly due to protein denaturation or nutrient leaching during cooking (El-Adawy, 2002).





Phosphorus concentrations remained relatively stable in both legumes, with fenugreek showing a slight increase from 0.32% to 0.33% and cowpea exhibiting a minor increase from 0.22% to 0.27%. Sodium levels remained consistent,

with fenugreek decreasing from 0.71% to 0.66% and cowpea showing a slight reduction from 0.69% to 0.68%. Phosphorus levels remained relatively stable in both legumes. Earlier studies indicate that phosphorus is generally less affected by cooking compared with other minerals (Iqbal et al., 2006). Sodium content showed only minor reductions after boiling, supporting earlier reports that sodium levels in pulses change only slightly during cooking (Rao & Deosthale, 1982).

Following cooking, the potassium content in cowpea increased significantly from 0.03% to 0.11%, while fenugreek experienced a decrease from 0.13% to 0.09%. This suggests that boiling may enhance potassium availability in cowpeas, but not in fenugreek. Potassium content increased in cooked cowpea but decreased in fenugreek, suggesting species-specific responses to cooking processes (Hefnawy, 2011). Both legumes exhibited increased concentrations of calcium and magnesium during cooking; cowpea's calcium rose from 0.14% to 0.25%, and magnesium increased from 1.51% to 3.93%. In fenugreek, calcium concentration decreased from 0.26% to 0.23%, while magnesium content increased from 3.43% to 3.83%. Calcium and magnesium levels increased after cooking in cowpea, which may be attributed to improved mineral extractability from plant tissues (Luo et al., 2014).

The sulfur content of both legumes increased after boiling, with cowpea rising from 2.93% to 3.76% and fenugreek from 3.94% to 4.07%. While fenugreek's boron content decreased from 9.67 PPM to 8.69 PPM post-cooking, cowpea's boron levels remained relatively unchanged. Sulfur content increased after cooking in both legumes. Sulfur content increased after cooking in both legumes.

Zinc concentrations exhibited contrasting trends; fenugreek increased from 46.15 PPM to 58.26 PPM, whereas cowpea's zinc content decreased from 41.51 PPM to 34.24 PPM, indicating that heating may differentially affect zinc bioavailability in these legumes. Zinc levels increased in fenugreek but decreased in cowpea, indicating that heat processing can affect micronutrient availability differently among species (Hemalatha et al., 2007). Following boiling, the ferrous content increased in both legumes, with fenugreek rising from 880.95 PPM to 921.70 PPM and cowpea from 333.39 PPM to 337.72 PPM, suggesting that cooking enhances iron bioavailability. Iron concentration increased in both legumes after cooking, suggesting improved iron availability (Hallberg & Hulthén, 2000; Hotz & Gibson, 2007).

Copper concentrations in cowpea decreased from 49.95 PPM to 23.56 PPM, while fenugreek's copper content increased from 51.65 PPM to 69.77 PPM. Similar variations in copper content of legumes after thermal processing have been reported in earlier nutritional studies, where cooking and boiling were found to influence trace mineral availability and leaching (Hefnawy, 2011; Campos-Vega et al., 2010).

Manganese concentrations rose in fenugreek from 131.72 PPM to 142.65 PPM, whereas cowpea's manganese levels declined from 23.34 PPM to 21.71 PPM. which may be due to species-specific mineral retention and the effect of cooking on cellular structure and mineral extractability (Shimelis & Rakshit, 2005; Luo et al., 2014). Cowpea's molybdenum content increased from 0.32 PPM to 0.56 PPM, while fenugreek's decreased from

0.61 PPM to 0.48 PPM, indicating that trace mineral concentrations in legumes may either increase or decrease depending on cooking conditions, mineral binding, and seed composition (Mudryj et al., 2014).

The ash concentration, indicative of total mineral content, increased in cowpea from 4.1% to 7.3% and decreased in fenugreek from 7.2% to 5.3%. Cowpea's moisture content exhibited a slight decrease from 11.2% to 10.4%, whereas fenugreek's moisture content increased from 10.4% to 13.4%. Ash content increased in cowpea but decreased in fenugreek after cooking, indicating variations in total mineral content. Moisture content also changed after cooking, reflecting water absorption and structural changes in legume seeds during thermal processing (Shimelis & Rakshit, 2005).

Conclusion:

According to this study, cooking some legumes affects the minerals they contain. Cooking cowpea brought down the amounts of nitrates more than cooking fenugreek. This could make the food safer and better for you. Changes in nitrogen levels reveal that heating may raise the protein in cowpeas and lower the protein in fenugreek. Calcium, magnesium, and potassium levels rose due to extractability and fell due to leaching or changes in seed structure after heat treatment. The two beans have different amounts of zinc, copper, manganese, and molybdenum. The statistics show that cooking cowpeas and fenugreek has a big effect on their nutritional value and the amount of minerals they can absorb. Boiling can raise the levels of iron and some other elements, but lower the levels of others, depending on the type of seed and how it is processed. So, to make these beans more nutritious, they need to be prepared correctly. The research underscores the significance of cowpea and fenugreek in a balanced diet and promotes their incorporation into food systems and sustainable agriculture.

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