Legumes can help to eliminate trace element deficiency in Africa

Nutrient-poor soils in Africa is a pressing issue. As a result, many people in the African continent suffer from nutrient deficiency due to not being able to access nutritious foods. This is what makes the work of Professor Felix D. Dakora of Tshwane University of Technology so important. His pioneering research into finding foods that will enable increased nutrient consumption in the diet, and his work demonstrating that the application of nitrates, typically found in fertilisers, can actually decrease the amount of trace elements in certain foods, is of vital importance for Africa’s rural populations.

Biological Sciences | Felix Dapare Dakora & Glory Chinonye Mbah

N utrient deficiency is a major health problem on a global scale, and nowhere is this issue more apparent than in Africa. Due to the inherently low concentration of nutrients in African soils, exacerbated by the common practice of cultivating crops without fertilisers, and the removal of left-over crop residues after grain harvest, nutrient deficiency is a serious problem in the continent.

This is where the work of Professor Felix Dakora and his Research Group at the Tshwane University of Technology comes into play. Professor Felix Dakora is at the forefront of researching solutions that ensure people receive enough trace elements in their diets. Funded by the Bill and Melinda Gates Foundation, the National Research Foundation of South Africa, the South African Research Chair in Agrochemistry and Plant Symbioses, and the Tshwane University of Technology, Pretoria, Professor Felix Dakora is well placed to conduct this research.

A BACKGROUND TO THE PROBLEM

Due to the inherently low levels of nutrients in African soils, approximately 232 million people suffer from trace element deficiency in the African continent. Examples of common nutrients that people are deficient in include iron, zinc, selenium and iodine. Trace elements are chemical elements present only in minute amounts in soil and have a relatively low presence in foods. Despite being found in low levels, these trace elements are nonetheless important.

In small doses, they are vital for brain development and are purported to reduce the risk of chronic diseases such as cancer, cardiovascular disorders and age-related degenerative diseases. Their deficiency can also lead to stunted growth, a critical issue when considering that many children suffer from trace element deficiency in Africa.

In South Africa, the problem is so severe that there is now a policy of supplementing food materials for children with trace elements such as iron, zinc and selenium in order to meet the dietary requirements recommended by the World Health Organization. While this is of course a necessary short-term solution, it is not sustainable in the long-term.

Although eating seafood, dairy products and meat can provide trace element supplements to the diet, this is not a feasible solution for poorer communities in rural Africa, as these communities cannot afford these types of foods.

THE POTENTIAL OF LEGUMES

Due to not being able to rely on animal products for nutrition, Professor Felix Dakora has been researching ways in which to increase trace elements in peoples’ diets through increasing the consumption of certain types of vegetables over others, and has specifically been researching the potential for legumes to be used as a way of increasing the amount of trace elements that people have access to in their diets.

Legumes are already known for their ability to provide plant protein, but there has been little assessment of the relationship between legumes and mineral accumulation prior to Professor Felix Dakora’s research. A legume is a type of flowering plant that has a symbiotic relationship with nitrogen-fixing bacteria in the soil.

This means that the bacteria live in the root systems of the plant and convert nitrogen gas from the air into ammonia, which is then used by both the bacteria and the plant for growth. As a result, legumes are able to take up more mineral nutrients from the soil, thus increasing the amount of trace elements that they contain.

In a comprehensive study undertaken in 2005 and 2006, Professor Felix Dakora proved the benefits of consuming a particular legume, commonly known as cowpea, as a way of increasing trace elements within the diet. In this study, the concentrations of trace elements within the leaves and grain of 27 different types of cowpea were assessed, and it was found to contain up to three times more iron than is found in spinach! This study showed the potential of cowpea consumption for preventing trace element deficiency in rural African communities, especially within children; this has huge implications for human nutrition and health.

To further this research, Professor Felix Dakora and his Group also studied the concentrations of trace elements in the different genotypes of cowpea. Genotypes are types of the same species but with slightly different genetic makeups. This research has incredible practical implications. For example, if certain genotypes of cowpea have higher concentrations of trace minerals, then less of their leaf matter needs to be consumed in order to obtain a satisfactory amount of trace elements in the diet. This means that growing certain types of cowpea over others for consumption has huge health benefits.

Professor Felix Dakora’s work also indicates that the cowpea genotypes that contain higher amounts of trace elements in their leaves are high nitrogen fixers, due to their physiological make up. This means that they are efficient at the process previously mentioned, and they are able to accumulate large amounts of nitrogen in their biomass.

Understanding this is crucial, with careful breeding of select plants, the high nitrogen-fixing trait could be enhanced. This research has the potential to overcome trace element deficiency in rural Africa through plant breeding.

Significantly, this research shows that the consumption of legumes has great potential to decrease trace element deficiency in humans. While the study did not necessarily indicate how these trace elements will be processed when consumed, Professor Felix Dakora has paved the way for further research, in particular to identify suitable plants that exhibit high levels of trace elements in edible plant parts.
Significantly altered the concentration of nitrates to five different legume species of his study showed that adding plants (including cowpea) would respond have the opposite intended effect. This of increasing trace elements in diets undertaken in 2012, along with student crop yields, and therefore food security, thought of as the solution to increasing global warming. Despite this, they are ground and water pollution, as well as to are notorious for contributing both to the dietary value of legume leaves. Professor Felix Dakora has paved the way for further research, showing that more needs to be done to identify suitable crop plants that exhibit high levels of trace elements.

Professor Dakora's research investigates biological nitrogen fixation with a focus on the legume, the interaction between microbe and host plant, as well as the microbe itself. The Bill and Melinda Gates Foundation, the National Research Foundation of South Africa, the South African Research Chair in Agrochemistry and Plant Symbioses, and the Tshwane University of Technology, Pretoria.

Research Objectives

- To improve the nutritional value of legume leaves.
- To identify suitable crop plants that exhibit high levels of trace elements.

References


Personal Response

What further research needs to be done on trace element deficiency? Getting beneficial soil microbes to promote greater trace element uptake by cereal crops is our next research activity. Because soil bacteria (rhizobia) can increase the concentrations of trace elements in nitrogen-fixing legumes, this means that a sustainable solution to the current practice of supplementing maize with trace elements in South Africa can be found by identifying effective soil microorganisms that can promote increased absorption of these trace elements by maize and other cereal crops. That way, the greater concentrations of trace elements in cereal grain will help to eliminate trace element deficiency in Africa. More research also needs to be done to identify many different food plants that show high levels of trace elements in edible parts. Additionally, there is a need to understand how these trace elements are processed in the human body when consumed in food. Furthermore, we need a better understanding of how trace elements are reduced when nitrate is supplied to the plant. My ultimate aim is to completely eliminate trace element deficiency in rural Africa using food plants that have the ability to take up more trace elements from soils.

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