



Seed pods of *Moringa olifera*

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# Harnessing the nutritional benefits of the mighty moringa tree

A relatively new food crop in South Africa, the moringa tree is known for its health benefits: a moringa leaf is almost a third protein and contains many vitamins and minerals. Medicinal properties of the plant, native to the Indian sub-continent, include anti-inflammatory, antioxidant and anti-diabetic properties. Better still, the tree is fast-growing and drought-tolerant, and so is well adapted to the South African climate. As the popularity of the plant grows, so too does the need to understand how growing conditions affect the bioactive compounds that make it so attractive as a means for alleviating poverty and food insecurity.

By **Andrea Teagle**

The cultivation potential of the moringa tree (*Moringa oleifera*), which is native to the Indian subcontinent, has already been demonstrated in many countries. However, variation in quality remains a challenge. In South Africa, where the moringa industry is in its infancy, the Department of Science and Innovation [supports the cultivation](#) of the high-protein crop to alleviate food insecurity.

How does the moringa tree produce its abundance of vitamins, minerals and anti-inflammatory compounds? The concentration of beneficial bioactive compounds in healing plants differs depending on growing conditions. In South Africa, traditional healers have in the past claimed that cultivated indigenous plants [lack the potency](#) of their wild-grown counterparts. This might have a scientific basis: for example, some bioactive compounds are the plant's defence against insects or other pests that farmers kill with pesticides. In other instances, wild-grown medicinal plants might have greater concentrations of certain compounds simply because they are older than faster-growing cultivated varieties.

On the other hand, cultivating plants offers the opportunity to carefully control the growing process, from nutrient availability to temperature. Hydroponic systems, for example, which use fertiliser solution in place of soil, can produce consistently high-quality yields in certain medicinal plants elsewhere in the world.

How cultivation conditions affect the quality of moringa products in South Africa, in particular the concentrations of medicinal compounds, remained an open question. Led by the HSRC's Lavhelesani Managa, a team of researchers set out to answer it.

## Nature and nurture

In 2018, Manga and his team set up their study in the humid city of Pretoria, Gauteng – one of six provinces where [the tree is grown in South Africa](#). The others are Mpumalanga, KwaZulu-Natal, Free State, North West and, most commonly, Limpopo, where it is mostly grown at the household level. They planted two cultivars of interest: the PKM-1 variety and the so-called Malawi hybrid. Half the seeds were sown in a field and the other half in hydroponic systems in shade-cloth covered greenhouses.

Hydroponic farming is increasingly popular in South Africa, as it uses less water, expanding growing possibilities in dry areas. While shade cloth does not allow for full control of the environment, it is an affordable option for South Africa's small-scale farmers.

In the summer of 2018, the team harvested leaves from both types of moringa in the field and the hydroponically cultivated trees. They did the same in autumn (May) and then tested the leaves for concentrations of the compounds of interest. The post-harvesting processes were standardised across the groups: the leaves were airdried in a dark room at room temperature, ground into a powder and stored in a -80-degree freezer until processing.

Then they analysed the samples. The team was particularly interested in moringa's medicinal properties. They measured and compared the concentrations of seven bioactive compounds that might account for its anti-fungal, anti-inflammatory, anti-diabetic and antidepressant properties. These included chlorogenic acid (also found in coffee beans); ferulic acid, esculetin and niazirin (all antioxidants); vanillic acid (also found in vanilla plants); wagonin compounds; and GABA (a natural brain relaxant).

## Hydroponic healers

The analysis revealed that in both types of moringa, the medicinal compounds in the leaves are most concentrated in summer; and that trees grown hydroponically have, on balance, higher concentrations of bioactive compounds. Hydroponic conditions appeared particularly beneficial for PKM-1, which showed statistically significantly greater concentrations of chlorogenic acid, ferulic acid and vanillic acid, compared with its field-grown counterparts.

The differences in concentrations of compounds between field- and hydroponically-grown plants were also more pronounced in the summer harvest.

Only one of the compounds, GABA, favoured field cultivation, according to the analysis.

The team notes that isolating individual factors that contributed to these differences is not possible, particularly as they likely interact with one another and with the genetics of the plant. However, carefully controlling environmental factors, including fertiliser mix, water salinity, temperature, humidity and light, appeared to promote better-quality moringa in terms of its bioactive compounds.

They write, 'continuous supply of fertiliser solution may provide ideal conditions ... particularly when plants are placed under osmotic or salt stress, which boost the natural bioactive compounds of plants.'

Higher concentrations of compounds in the hydroponically-grown plants may have an effect on the antioxidant, anti-diabetic, anti-microbial and anti-inflammatory bioactivity of the leaf products, the authors write.

### Sun lovers

Another notable finding is that the moringa trees produced higher concentrations of bioactive compounds in the summer versus the autumn harvests. The tree's preference for warmer temperatures is good news for South African farmers, particularly in hot areas like Limpopo.

For the Malawi hybrid, chlorogenic acid was significantly higher in summer, while in the PKM-1 variety the summer-harvested leaves had higher qualities of all seven of the targeted bioactive compounds. The difference was significant for both hydroponically-grown plants and field-grown plants.

Which type of moringa tree has greater medicinal properties? The cultivars came out about even, with the Malawi variety having boasted greater concentrations of esculetin, niazirin, wogonin and GABA, while PKM1-1 had higher levels of chlorogenic acid, ferulic acid and vanillic acid.

Although in the case of moringa, desirable properties on balance increased with temperature, irrigation and consistent fertiliser, this will not be the case with all plants. According to Managa, the method could be adapted and used to investigate the cultivation potential and optimal growing conditions of other medicinal plants and herbs, including traditional medicinal plants that are indigenous to South Africa.

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