

Plant solutions

Dr Kit Chin leads the way in research to assess the viability of the roselle plant as a crop for farmers in Louisiana. Here, he discusses the importance of collaboration and the significance of his work

DR KIT CHIN



To begin, what inspired the creation of this project?

In recent decades, a great deal of information about the relationship between human health and diet has become available. As a consequence, health conscious consumers have increased the demand for natural foods tremendously. To satisfy demand, progressive research efforts seek to identify which natural foods, herbs and botanicals contain properties beneficial to health and explore the potential application of plant-based substances to mitigate human chronic diseases.

Roselle hibiscus has a number of positive attributes which make them an ideal candidate

for a functional food crop in small farms: the plant is easy to grow; it has demonstrated medicinal properties (a niche factor for marketing) and can fetch high market price; there is no fresh roselle hibiscus produce (calyce and leaves) currently available in the US; it is versatile for a number of uses; and has a worldwide demand.

Are there any shortcomings of growing roselle hibiscus in Louisiana?

The three main concerns with existing varieties are that the crop has to be harvested completely before any freezing temperatures in the fall; it demands a great deal of manpower to harvest and peel the calyces from the fruits; and if the harvest is delayed then powdery mildew disease may occur if preventive measures are not undertaken.

How will your research help to overcome such issues?

Through plant import permits from the US Department of Agriculture Animal and Plant Health Inspection Service, we are able to obtain new germplasm for trial from all over the world. With these resources, we can continue the selection process to ensure the best early maturing cultivars are available for production (mass selection).

We will also carry out micro-grafting to possibly induce resistance to soil-borne diseases and 'earliness in production', although,

at this point, we are not sure about this method in inducing earliness in production.

Do you undertake outreach activities to improve the awareness of roselle's potential?

Since this is a new crop which is unknown to almost all of Louisiana, it is very important that we undertake workshops and promotional events to educate potential growers. It is via our Southern University Agricultural Research and Extension Center webpage, national TV broadcast, *This Week in Louisiana Agriculture* scientific presentations, workshops, field days and Southern University legislative day in the state capital, that roselle hibiscus has become known to many in Louisiana.

Who have been the primary partners in this initiative?

Our research is multidisciplinary and multi-institutional in nature. It utilises the various expertise of the collaborators to effectively and efficiently achieve common research goals with minimum expenses. This approach also helps to build our research capability credentials.

Drs James Simon and QingLi Wu, from Rutgers University's New Use Agriculture and Natural Plant Product Program, work collaboratively with us on the isolation and identification of health-benefiting substances from these plants. While Dr Gerald Hankins from West Virginia State University works with us to evaluate the



roselle hibiscus extracts on anti-carcinogenic properties of several lines of human cancer cells *in vitro*. Dr Tomothy Rinehart of the US Department of Agriculture's Agricultural Research Service (USDAARS) will conduct genetic identity and relatedness of roselle hibiscus lines with the research team.

Could you outline the wider importance of this research?

First, our research findings can be translated to an evolution of adaptable roselle hibiscus functional food crops for small-scale farmers in Louisiana and southern US (similar to that of citrus adopted and grown by farmers in the southern states). Second, we envision that a roselle hibiscus-related products industry will emerge to strengthen Louisiana's economy and broaden their current focus on winery and beverage plants. Third, our findings and natural product development strategies may spin off into other ventures and there is no doubt that this research will contribute to the scientific natural plant product database of USDA/ARS.

In the long term, this research can help to promote market enterprises for small, resource-limited farms and develop a new product industry in Louisiana. I can also foresee roselle hibiscus playing a significant role in the nutritional supplement market. While more research is needed to substantiate and validate current research findings, I am confident that our efforts will be fruitful.

As the global market of herbs and botanicals reaches US \$19 billion with an expected annual increase of 6.6 per cent, scientists at the **Southern University and A&M College** have begun to explore the potential of a domestic market in Louisiana

SINCE ITS INITIATION in 2003, the 'Buy Fresh Buy Local' network has spread across the US with remarkable success. The network promotes local food whilst focusing on increasing the success of the food system it supports. Awareness of the cause has also amplified interest and concern about the provenance of food, yet, for the roselle hibiscus (*Hibiscus sabdariffa*), popular for its edible leaves and fleshy red fruit calyces, its potential has remained untapped in domestic markets.

Hibiscus comprises more than 300 species, distributed in tropical and subtropical regions around the world. Most species are used as ornamental plants, though many are believed to have medicinal properties. In particular, roselle is used in fresh salads, tea, juices, jellies, jams, ice cream and spices for cooking. Dried roselle hibiscus calyces are one of the major botanicals imported yearly by the US. Keen to support local industry and the growing demand of local, healthy food sources, Dr Kit Chin of Southern University Agricultural Research and Extension Center, Baton Rouge, Louisiana, and colleagues at Rutgers University and West Virginia State University are undertaking a feasibility study which could stimulate economic roselle hibiscus production in the US, and increase the quality and shelf life of roselle by-products.

The team conduct research which will find appropriate cultural practices to grow roselle hibiscus as a small-farm and niche market crop and find alternative utilisation to enhance marketability. Southern University Agricultural Research and Extension Center (SUAREC), as a part of the Southern University and A&M College System, works to Link Citizens of Louisiana with Opportunities for Success. Running since 2005, the project went on to receive a research grant from US Department of Agriculture National Institute of Food and Agriculture (USDA/NIFA) Capacity Building Grants Program in 2009.

Central to the project's short-term goals is the development of suitable hibiscus cultivars which could adapt to Louisiana weather

conditions and be suitable for small-scale farming. Looking at the bigger picture, explains Chin: "Our research will help promote market enterprises for small, resource-limited farms and develop a roselle hibiscus-related product industry in Louisiana".

FROM THE GROUND UP

Roselle is one of the highest volume speciality botanical products in international commerce and can adapt to a variety of climatic and soil conditions. The plant is also a niche crop with a high cash market value, so could prove useful to US farmers looking to diversify their business. In Louisiana, the growing season is long enough for early maturing roselle hibiscus varieties. To provide a high yielding variety, the team was faced with finding a variation of the plant which featured early production as well as healthy plant growth, disease resistance and a high quality of calyces (sepals of the flower). Alongside these stipulations, the fruit and leaves would need to be quickly and easily harvested to avoid the onset of freezing weather in November and December and the resulting mildew of a failed harvest.

In order to identify which strain of roselle was most suited to planting in Louisiana, the team initially evaluated 27 roselle hibiscus accessions found to be most suitable for cultivation in US soil



co-PI DR YADONG QI, AND A BUMPY OF ROSELLE HIBISCUS CROP

INTELLIGENCE

ALTERNATIVE UTILISATION OF ROSELLE HIBISCUS AS SMALL FARM AND NICHE MARKET CROP

OBJECTIVES

- To validate the performance of selected roselle hibiscus accessions from phase I and to develop appropriate cultural practices for the production of calyces: genetic identification of roselle hibiscus accessions, evaluation of fertilisers, and evaluation of the effects on dates of planting
- To produce container-grown flowering roselle hibiscus plants for seasonal occasions
- To develop an alternative niche market for roselle hibiscus value-added products to promote small-scale commercial market
- To assess roselle hibiscus as a nutritive and natural deworming forage for goat production
- To further evaluate the refined extracts of roselle hibiscus calyces and leaves for their antagonistic and anti-proliferation effects on selected human cancer cells

PARTNERS

West Virginia State University

Rutgers University

US Department of Agriculture/Agricultural Research Service

KEY COLLABORATORS

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KIT CHIN is a professor in horticultural research and has more than 30 years of experience in university teaching, research and outreach relating to sustainable horticulture. He pioneered the establishment of the first US urban forestry academic programme and provided leadership to achieve national prominence in urban forestry teaching and research. Currently he is the Project Director for the multi-state research project on the evaluation and selection of roselle hibiscus accessions for product development as a niche market and functional food crop for urban and small family farms.



Dr Gerald Hankins of West Virginia State University studies the effect of roselle hibiscus calyce extract on apoptosis of cancer cells.



from the US Department of Agriculture/National Clonal Germplasm Repository. Subsequently four accessions were selected from Nigeria, Jamaica, Senegal and South Africa. Through further investigations and accession screening, the group revealed a potentially new variety – Thai Red – which showed early flowering and the most conducive horticultural characteristics. Alongside these studies, the team also attempted to develop soil borne, disease resistant roselle through the use of micrografting, a technique mainly used on vegetables.

Chin and his group have also been investigating the conditions best suited for healthy plant growth. They have carried out studies into the effects of organic fertiliser applications on elemental composition, total polyphenols and total antioxidant content of roselle calyces and leaves to determine the ideal level of external inputs. A field experiment was conducted in Baton Rouge. Three levels of 4-2-2 ground and 8-5-5 pelletised organic fertilisers respectively were applied at the planting of roselle. The responses to these two forms of organic fertilisers varied. They discovered that in general, ground organic fertiliser, at a higher rate, increased elemental nutrients such as nitrogen, phosphorus, potassium, calcium, magnesium, sulphur and zinc in leaves of one roselle hibiscus accession. They also observed that pelletised organic fertilisers had no significant effect on most macro- and micro-elemental composition of the calyces. Pelletised organic fertiliser reduced calcium and zinc content of the calyces but increased manganese.

PLANT MEDICINE

Beyond field studies, the team's project has extended its reach into innovative investigations surrounding the medical benefits of roselle. For instance, West Virginia State University, an affiliated institute, began by studying an extract of roselle hibiscus for its effects on arresting the proliferation of animal and human cancer cells *in vitro*. Scientists at SUAREC have been using this research to develop hibiscus products, including *Hibiscus sabdariffa* extract, as a nutritional supplement to prevent certain cancers.

Since then, SUAREC has gone on to focus on the antibacterial effects of roselle hibiscus calyce

and leaf extracts on *E. coli*, *Salmonella enterica*, and *Listeria monocytogenes*. They found that aqueous extracts, of both roselle leaves and calyces, were effective in reducing bacteria population *in vitro* culture. With this finding, the team is currently undertaking research to assess the effect of roselle calyce powder on bacteria inhibition on meat with an attempt to develop an effective roselle hibiscus antimicrobial mix to be used on meats to prevent possible food-borne bacteria contamination.

FUTURE PLANS

The potential for roselle as a cash crop for US farmers is gaining recognition amongst the farming community as a direct result of Chin and his collaborators. By broadening the knowledgebase of information surrounding the ideal growth conditions and demonstrating their healing powers, the plant could prove to be a valuable commodity for a sector struggling to make a living. Public outreach and social media has been key component of the project, as Chin is aware of the need to gain the support of the local community. Indeed, without it, people would be unaware of the plants' many uses. "In terms of its potential for food, our research has found that roselle hibiscus is equally effective in producing quality roselle jelly and a drink from the whole shoots instead of calyce alone," Chin highlights.

To maximise the benefits of each harvest, Chin will now look into the feasibility of extracting all of the medicinal benefits without sacrificing the intended use of the crop as a food source. "For example, we hope to harvest the whole shoot instead of just calyce for the making of roselle hibiscus jelly, drinks and wine, and find alternative uses of the plants, such as marketing the leaves as vegetables as they are rich in minerals and vitamins," he concludes.

Niche products are an emerging market that has really caught hold in recent years. Hibiscus may seem like an unconventional pathway for many farmers, although it appears to be logical in terms of its numerous beneficial properties. Next, Chin hopes to develop a roselle hibiscus business incubator to provide training and the facilities to jump-start entrepreneurship development and ease the transition to a farm-ready product in the near future.