Proceedings

Indigenous Plant Foods for Nutrition and Health

A joint virtual Workshop between

The ARC Industrial Transformation Training Centre for Uniquely Australian Foods (ARC ITTC UAF), Queensland Alliance for Agriculture and Food Innovation (QAAFI), The University of Queensland, Brisbane, Australia

and

The SARChI Research Programme in Phytochemical Food Network to Improve the Nutritional Quality for Consumers, Tshwane University of Technology, Pretoria, South Africa

24th & 25th August, 2021

8 AM-10 AM Pretoria, South Africa

4 PM-6 PM Brisbane, Australia

Edited by Michael E. Netzel, QAAFI, The University of Queensland

Convenors:

Professor Dharini Sivakumar, Tshwane University of Technology

DSI-NRF Professor Dharini Sivakumar is attached to the Tshwane University of Technology (Pretoria Technikon) as a South African Research Chair (SARChI) in the Phytochemical Food Network to improve the Nutritional Quality for Consumers. The Phytochemical Food Network programme focus on interdisciplinary research programmes to create small and medium based agro processing industries targeting newly innovative functional food from indigenous plant-based resources. This research programme also aims to improve the bioeconomy via the grass root innovations by creating employment and preserving culture & heritage to empower the rural communities.

Professor Yasmina Sultanbawa, The University of Queensland

Professor Yasmina Sultanbawa is the Director of the ARC Industrial Transformation Training Centre for Uniquely Australian Foods and a Professorial Research Fellow at the Queensland Alliance for Agriculture and Food Innovation (QAAFI), the University of Queensland, Australia. Some of her research is focused on Australian native plant foods and incorporation of these plants in mainstream agriculture and diet diversification. Working with indigenous communities to develop nutritious and sustainable value-added products from native plants for use in the food, feed, cosmetic and health care industries is a key strategy. The creation of employment, economic and social benefits to these remote communities is an anticipated outcome.

PROGRAMME

Day 1: 24th August 2021 (Tuesday)		
Session Chair	**Dr Michael E. Netzel**	
Opening of the workshop	**Professor Yasmina Sultanbawa**	
Presentations from The University of Queensland		
Presentation 1: Ms Sukirtha Srivarathan (PhD Student)	Novel sources of functional ingredients: The potential of Australian Indigenous Edible Halophytes	14 min
Presentation 2: Ms Jaqueline Moura Nadolny (PhD Student)	Bunya nut as a versatile gluten-free source for flour production	14 min
Presentation 3: Mr Michel Beya (PhD Student)	Bioactivities of Kakadu plum in meat systems	14 min
Presentation 4: Ms Gengning Chen (PhD Student)	Nutritional quality and food functionality of *Pleiogynium timoriense* fruit	14 min
Presentations from Tshwane University of Technology		
Presentation 1: Dr Tinotenda Shoko (Postdoctoral Researcher)	Optimisation of the phenolic metabolites and antioxidant activity of *Cucurbita moschata* Duchesne ex Poir leaves during drying, using the UPLC-QTOF MS tool and a chemometric approach	14 min
Presentation 2: Ms Faith Seke (PhD student)	Effect of freeze-drying, methanolic and ethanolic extraction, alkaline and acid hydrolysis on the antioxidant capacity and bioaccessibility of free and bound phenolic compounds of Natal plum fruit (*Carissa Macrocarpa*)	14 min
Presentation 3: Ms Petunia Mashiane (PhD student)	A comparison of bioactive metabolites, antinutrients and bioactivities of African pumpkin leaves (*Momordica balsamina* L.) cooked by different culinary techniques	14 min
Presentation 4: Dr Vimbai Edna Manhivi (Postdoctoral Researcher)	Co-ingestion of Natal plums (*Carissa Macrocarpa*) and Marula nuts (*Sclerocarya birrea*) in a snack bar and the effects on phenolics, anthocyanins, antioxidant capacity and α-glucosidase inhibition.	14 min

Day 2: 25th August 2021 (Wednesday)		
Session Chair	**Associate Professor Heather Smyth**	
Presentations from The University of Queensland		
Presentation 1: Mr Oladipupo Q. Adiamo (PhD Student)	Nutritional and functional characterization of Australian *Acacia species* from different regions	14 min
Presentation 2: Ms Clare Wijngaarden (PhD Student)	User perspectives of *Australian Native Foods*	14 min
Presentation 3: Ms Gethmini Kodagoda (PhD Student)	Does storage improve the phytochemical composition of 'Queen Garnet Plum'?	14 min
Presentation 4: Mr Eshetu Bobasa (PhD Student)	Hydrolysable tannins in *Terminalia ferdinandiana* Exell fruit powder and comparison of their functional properties from different solvent extracts	14 min
Presentations from Tshwane University of Technology		
Presentation 1: Dr. Stephen A. Akinola (Postdoctoral Researcher)	Colour properties and *in vitro* bioaccessibility of fermented chayote leaf (*Sechium edule*) and pineapple (*Ananas comosus*) smoothies	14 min
Presentation 2: Ms Prosperity Nompumelelo Nikosi (MSc Student)	Phytochemical composition, antioxidant properties of selected Southern African indigenous fruits	14 min
Presentation 3: Ms Charmaine J.T. Phahlane (PhD Student)	Composition of phytochemicals in the leaves of sweet potato varieties (*Ipomoea batatas* L.) from South Africa	14 min
Closing of the workshop	**Professor Dharini Sivakumar**	

ABSTRACTS:

Novel sources of functional ingredients: The potential of Australian Indigenous Edible Halophytes

Sukirtha Srivarathan[1,3*], Anh Dao Thi Phan[1], Olivia Wright[2], Yasmina Sultanbawa[1], Michael E. Netzel[1]

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Edible halophytes are receiving more attention due to their ability to tolerate a wide range of salinities, which is a crucial trait in times of climate change, growing world population and loss of arable land. In Australia, edible halophytes are used in a broad range of "applications" by Indigenous communities: in traditional cuisine, as livestock feed and for soil bioremediation. However, very limited scientific information is available on their nutritional composition and bioactivity. Therefore, the aim of the present study was to determine the nutrient and phytochemical composition of Australian-grown Samphire (*Tecticornia sp.*), Seapurslane (*Sesuvium sp.*), Saltbush (*Atriplex sp.*) and Seablite (*Suaeda sp.*) to better understand their nutritional value, bioactivity and subsequently potential to be utilized as functional (food) ingredients. Proximate and fiber varied significantly ($p < 0.05$) between the studied halophytes with Samphire having the highest fiber content of 46.8 g/100 g dry weight (DW). Furthermore, the four tested halophytes could be identified as valuable sources of essential minerals and trace elements (especially Ca and Fe), protein (up to 20.1 g/100 g DW) and fat (up to 2.7 g/100 g DW). The fatty acid profile consisted mainly of palmitic, stearic, oleic, linoleic and α-linolenic acid. It should be also mentioned that the determined anti-nutrients (hydrolysable tannins, phytates, saponins and trypsin inhibitors) were generally lower than those in spinach, which is a "popular relative" from the same plant family and therefore used as a control. The results of the present study are promising and suggest that Australian indigenous edible halophytes may have the potential to be utilized as functional food ingredients or as a healthy side dish.

Bunya nut as a versatile gluten-free source for flour production

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Bunya nuts, in contrast to most other nut varieties, are low in fat and high in starch. Since they also do not naturally contain gluten, they produce a flour that is gluten-free. This study investigates the suitability of using bunya nut flour in the food industry by assessing the influence of different methods of preparation (untreated, fermentation, boiling and roasting) on the functional and pasting properties of the flour. The functional properties were evaluated by applying standard methods for flour analysis. The pasting properties were investigated by using a programmed heating and cooling cycle in a rheometer with a starch cell attached. It is found that untreated flour provides higher foam capacity and emulsion activity, being more suitable for confectionaries. Boiled and roasted nuts produce flours with increased water absorption, desirable for dough handling and bread production. Fermented flours showed, unexpectedly, the highest pasting viscosity. This can happen due to leaching of soluble matter during fermentation, thus concentrating the water-binding compounds. This flour could improve gas retention capacity, cohesiveness and elasticity of doughs. The final product is suitable to be used in different applications according to the resulting properties. Future work will investigate the interaction of the compounds present in each flour and test the use of these flours in a range of bakery products. The outcomes generated by this study may assist Indigenous communities who harvest, sell and process bunya nuts, since the production of flour adds steps that improve their value chain and increase their market price.

Bioactivities of Kakadu plum in meat systems

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The increased awareness on the safety of food preservatives, and consumer leanings to avoid foods containing synthetic preservatives, due to their negative "image" or potential health risks, triggered the search for alternative natural substances to preserve foods. Plant materials have been reported to contain bioactive compounds that can play an important role in the preservation of foods including meat and meat products. Native Australian plants have captured the attention of the scientific community as they can provide health benefits as well as be rich sources of bioactive compounds. Kakadu plum (Terminalia fernandiana) is one of the major Australian native plants that has attracted the interests of different industries due its exceptional high content in vitamin C and ellagic acid. However, in the food industry, particularly in the meat industry, there is a lack of scientific information on the bioactivity attributes of Kakadu plum when used as a natural preservative in processed meats. Preliminary results of our experiments show that 0.15% to 0.6% of Kakadu plum powder moderately delayed microbial growth (total viable counts) in raw beef

patties). However, no difference was observed in TBARS between the control and the Kakadu plum treated beef patties. Further studies on the antimicrobial and antioxidant properties of Kakadu plum and other Australian native fruit extracts in raw beef patties under refrigeration conditions are in progress.

Nutritional quality and food functionality of *Pleiogynium timoriense* fruit

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Pleiogynium timoriense, best known as Burdekin plum, is one of Australia's native fruits. Within Australia, it is mainly distributed from Cape York peninsular to southeast Queensland. It belongs to the family of *Anacardiaceae*, which includes several economically important fruits and seeds such as mango, cashew and pistachio. In recent years, there has been an increase interest in this species, with several publications indicating biological activities of the leaves, bark, seed, fruit of the plant extract, including anticancer, anti-inflammatory and antioxidant activities. Particularly, the fruits were found to exert strong antioxidant activity, several times higher than blueberries. The fruits are dark purple shaped like plums with a thin layer of flesh and large stone, traditionally consumed by Aboriginal people either raw or processed. Limited studies have reported on the nutritional quality and food functionality of Burdekin plum grown in Australia. Therefore, this study will evaluate the nutrition and phenolic compositions of Burdekin plum as well as its biological activities, probing its potential to be a functional food ingredient. This information will increase public awareness about Burdekin plum and assist Indigenous communities in realising the market potential of this fruit and its value-added product.

Optimisation of the phenolic metabolites and antioxidant activity of *Cucurbita moschata* Duchesne ex Poir leaves during drying, using the UPLC-QTOF MS tool and a chemometric approach

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Cucurbita moschata Duchesne ex Poir (pumpkin) leaves are a delicacy in several African communities. The leaves possess high levels of phenolics and have high antioxidant activity. To ensure a continuous supply in the lean season, the vegetables are commonly preserved by drying. This study aimed to optimise the health benefits of the dried leaves to the consumer by selecting the best drying method. Pumpkin leaves were dried using sun, solar, microwave, oven, freeze and oven drying. Dried leaves were evaluated for their colour, chlorophyll and ascorbic acid content, phenolic metabolite content and antioxidant activity. The results revealed that freeze drying retained total chlorophyll content, improved the phenolic metabolite concentration and the ascorbic acid content, and further enhanced the antioxidant activities based on the FRAP and ABTS assays. Freeze-dried leaves had higher concentrations of rutin, quercetin 3-galactoside, isorhamnetin 3-galactoside-6 rhamnoside, isorhamnetin 3-O-rutinoside compared to leaves dried using the other techniques. The UPLC-QTOF-MS and the chemometric approach revealed that the peak at *m/z* 609,1441, tentatively identified as quercetin 3-galactoside 7-rhamnoside, separated the freeze-dried leaves from other drying treatments and is the method to achieve optimal phenolic metabolite content, retain quality parameters such as the green colour, and enhance antioxidant activity of the dried pumpkin leaves for the benefit of consumer health.

Effect of freeze-drying, methanolic and ethanolic extraction, alkaline and acid hydrolysis on the antioxidant capacity and bioaccessibility of free and bound phenolic compounds of Natal plum fruit (*Carissa Macrocarpa*)

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Natal plum (*Carissa macrocarpa*) fruit is a natural source of functional ingredients. The fruit is rich in phenolic compounds, that have high functional properties. The first objective of the study characterized the effect of freeze-drying and simulated in vitro digestion on the phenolic composition, antioxidant capacity and α-glucosidase activity of Natal plum. HPLC-DAD and UPLC/QTOF/MS helped to identify and quantify phenolic compounds in the Natal plum hydromethanolic extract. DPPH, ABTS, and FRAP assays were used to determine the antioxidant capacity. Cyanidin-3-O-β-sambubioside and cyanidin-3-O-glucoside were the dominant anthocyanins in the fresh and freeze-dried Natal plum. Freeze drying did not affect the concentrations of both cyanidin compounds. Cyanidin 3-O-β-sambubioside showed a

bioaccessibility of 32.2% compared to cyanidin-3-O-glucoside (16.3%). FRAP and ABTS activities decreased in the small intestinal phase. Despite the abundance of anthocyanins in the methanolic extract, methanol is highly toxic and cannot be used in food applications, hence the second objective was to optimise ethanolic extraction. The optimum (38% ethanol and 16.7 mins of sonication) yielded 863.99 mg/kg FW of total phenolics and 421.52 mg/kg FW total anthocyanin content. Acid hydrolysis produced more bound phenolic compounds. Total phenolic content, cyanidin-3-sambubioside and cyanidin-3-O-glucoside strongly correlated with antioxidant capacity. The release of free and bound phenolics during simulated in vitro digestion was also investigated. The small intestinal digestion phase showed greater protocatechuic acid as a major breakdown product of anthocyanins. Natal plum fruit has a strong antioxidant capacity, and the optimal extract might be a potential functional ingredient.

A comparison of bioactive metabolites, antinutrients and bioactivities of African pumpkin leaves (*Momordica balsamina* L.) cooked by different culinary techniques

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Prior to consumption, African pumpkin leaves (*Momordica balsamina* L.) are generally cooked. In this study, commonly used household cooking methods were used (boiling, steaming, microwaving, stir-frying) to examine the effects on bioactive metabolites, carotenoids, antioxidant activity, antinutrients and inhibitory effects on α glucosidase and α amylase activities. A set of 14 bioactive metabolites, predominantly phenolic compounds, were identified using ultra-performance liquid chromatograph (UPLC) coupled to a time-of-flight mass spectrometer (QTOF). Furthermore, the basis for the performing of statistical analysis of these bioactive metabolites was on MetaboAnalyst software 5. The results showed that the four different types of household cooking methods had different effects on the bioactive metabolomics profile of African pumpkin leaves. Seven phenolic compounds variables, rutin, 4-caffeoylquinic acid (cryptochlorogenic acid), pseudolaroside A, isorhamnetin 3-O-robinoside, quercetin 3-galactoside and trans-4-feruloylquinic acid, had significant variation among the four cooking methods and found to be high in stir-fried leaves. Of all household cooking methods tested, stir-frying increased the content of lutein, β carotene and zeaxanthin by 60%, 146.15%, and 123.51%, respectively. Moreover, stir-frying increased the antioxidant activity (DPPH and ABTS) and the inhibitory activity of α- glucosidase and α- amylase. Compared to all four methods of household cooking, stir-frying reduced the antinutritive compounds compared to raw leaves. This work provides useful information to the consumers on the selection of suitable cooking methods for African pumpkin leaves.

Co-ingestion of Natal plums (*Carissa Macrocarpa*) and Marula nuts (*Sclerocarya birrea*) in a snack bar and the effects on phenolics, anthocyanins, antioxidant capacity and α-glucosidase inhibition.

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The bioaccessibility of Natal plum phenolics and the antioxidant capacity is significantly reduced after simulated digestion owing to degradation of anthocyanins and phenolics at near alkaline pH. These phenolics, especially anthocyanins, have a potential anti-diabetic effect which may only be conferred to the consumer if the degradation during digestion is reduced. Ingesting the fruit with a nut may improve anthocyanin and phenolic stability. In this study, the effect of co-ingesting Natal plums (*Carissa Macrocarpa*) and marula nuts (*Sclerocarya birrea*) on the anthocyanins, phenolics, antioxidant capacity and α-glucosidase inhibition capacity were determined. A Natal plum-marula nut bar was made by mixing the raw nuts and the fruit pulp in a ratio 1:1 (v/v) and drying the mix. Ultra-performance liquid chromatograph (UPLC) with a Waters Acquity photodiode array detector (PDA) coupled to a Synapt G2 quadrupole time-of-flight (QTOF) mass spectrometer was used to identify anthocyanins. The phenolic compounds and anthocyanins were then quantified using high performance liquid chromatography coupled to a diode-array detector (HPLC-DAD). Inclusion of Natal plum in the bar increased the total phenolic content, anthocyanin content, antioxidants capacity and α-glucosidase inhibition. Inclusion of marula nut in the bar reduced the total phenolic content, anthocyanin content, antioxidant capacity and α-glucosidase inhibition but increased phenolic and anthocyanin bioaccessibility. The total phenolic content, ferric reducing antioxidant power (FRAP), 2,2′-azino-bis-3-ethylbenzthiazoline-6-sulphonic acid (ABTS) inhibition capacity, DPPH inhibition capacity and α-glucosidase inhibitory activity decreased with digestion, but a reduced decrease was observed for the bar. Co-ingestion of Natal plum and marula nut increases anthocyanin and phenolic bioaccessibility, increases antioxidant capacity and α-glucosidase inhibition after simulated digestion compared to ingesting the fruit and nut separately.

Nutritional and functional characterization of Australian *Acacia species* from different regions

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Acacia seed (AS) is an underutilized legume widely distributed in the world, with majority of the species (>70%) found in Australia. Generally, the seeds are not only rich in protein, dietary fibre and potassium, but also possess antinutritional compounds. In recent years, there have been an increase in the cultivation of some Australian acacia species such as *Acacia victoriae*, *Acacia cowleana* and *Acacia coriacea* from different regions. However, there is limited information on the nutritional composition, anti-nutrients, antioxidant capacity and functional properties of the flour from these widely grown Australian AS species. Thus, the present study aimed to assess the nutritional properties of these three Australian AS species from different geographical regions. *Acacia cowleana* and *Acacia coriacea* seeds were characterized by high protein, fat, potassium and soluble carbohydrate. However, higher starch and fibre contents were present in *Acacia victoriae*. Anti-nutrients, total phenolics and total flavonoids were higher in *Acacia cowleana* and *Acacia coriacea* seeds, whereas *Acacia victoriae* had a higher antioxidant capacity. The highest water absorption and solubility index could be found in *Acacia victoriae* and *Acacia coriacea*, whereas *Acacia cowleana* had the highest oil absorption index. There was less variation in the composition and physicochemical properties within species from different regions, and all samples showed promising nutritional characteristics. Overall, the findings of the present study will assist the food industry in selecting the appropriate AS species for the development of new (functional) food products and other novel food applications.

User perspectives of Australian Native Foods

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Customers and end users are critical players in any FMCG value chain. It is important to understand what drives interest in a product and category in terms of how and which products are used, sought out, and ultimately valued by different groups of consumers. For the native food industry this information (market insight) can help stakeholders at all stages of the value chain: from primary growers (e.g. guiding on which foods to grow and how to grow them), for intermediaries (e.g. identifying opportunities on how to value add, process and pack foods), to product developers (e.g. what sort of products to incorporate them in) and marketers (e.g. what communication and education is required to best promote and appeal to their target audiences). Overall, market insight will help identify any key barriers or pain points associated with product use, as well as highlighting opportunities and direction for market initiatives moving forward. The aim of the present research is to collect a snapshot of general market interest and usage relating to Australian native foods. Results reported here will help inform future studies relating to both general and food specific research around determination of demand and value for Uniquely Australian Foods.

Does storage improve the phytochemical composition of 'Queen Garnet Plum'?

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Plums are a popular stone fruit, belonging to the genus Prunus, which are widely consumed around the world due to their attractive appearance, flavour, aroma and nutritional quality. Queen Garnet Plum (QGP), a Japanese plum (*Prunus salicina Lindl.*) cultivar, was developed as a high anthocyanin plum in a Queensland Government (Australia) breeding program. QGP has a very dark red-purple peel and flesh which is an indicator of its high anthocyanin content. Storage can significantly affect the phytochemical composition and nutritional quality of plums. This study was conducted to evaluate the effect of two common domestic storage temperatures (4°C and 23°C) on the main bioactive phytochemicals, anthocyanins and carotenoids, in QGP. Total anthocyanin content (TAC) in QGP (whole fruit) continued to increase significantly ($p<0.05$) up to 10 days of storage at 23 °C (2.3-fold increase), while the increase ($p<0.05$) at 4 °C was only by 1.2-fold after 10 days of storage. Similar to TAC, the total phenolic content (TPC) also increased significantly ($p<0.05$) at both storage temperatures, but was more prominent at 23°C. In contrast to TAC and TPC, total carotenoids showed a significant ($p<0.05$) initial decrease at both storage temperatures: 43% at 4°C and 49% at 23 °C (day 0 to day 4), but remained unchanged after that. The results of the present study demonstrate that the storage temperature can have a significant impact on the phytochemical composition and subsequently nutritional quality of QGP. However, the impact on bioaccessibility and bioavailability needs to be investigated further.

Hydrolysable tannins in *Terminalia ferdinandiana* Exell fruit powder and comparison of their functional properties from different solvent extracts

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Kakadu plum (KP), a native Australian fruit, is a rich source of vitamin C, minerals and phenolic compounds. A better understanding of the (phyto)chemical composition and

biological properties of KP will facilitate the development of functional KP products for different applications. This study identified and quantified hydrolysable tannins (HTs) in *Terminalia ferdinandiana* Exell (Kakadu plum) fruit, freeze dried powder extracted with 80% aqueous acetone (AA) and 80% aqueous acidified ethanol (AAE), using UHPLC–Q/Orbitrap/MS/MS. The vitamin C and ellagic acid were quantified by UHPLC-PDA. A total of seven HTs were identified: corilagin, 3,4,6-tri-O-galloyl-β-D-glucose, elaeocarpusin, chebulinic acid, chebulagic acid, helioscopin B, and punicalagin, with five classified as ellagitannins. The two extracts AA and AAE, comprised of gallic acid (2.5 and 2.2 mg/g DW), punicalagins α and β (2.8 and 1.3 mg/g DW), respectively, and both contained ellagic acid (~4 g/100 g DW). These extracts showed high antioxidant properties and strong antimicrobial effects against methicillin-resistant *Staphylococcus aureus* clinical isolate, *Staphylococcus aureus*, and *Shewanella putrefaciens*. These results suggest that Kakadu plum fruit is a rich, edible source of ellagitannins, ellagic acid and vitamin C with potential applications in food, cosmetic and nutraceutical industries.

Colour properties and in vitro bioaccessibility of fermented chayote leaf (*Sechium edule*) and pineapple (*Ananas comosus*) smoothies

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Chyote leaves (*Sechium edule*) are traditional vegetables, and the numerous nutritional and health benefits of chayote vegetables have encouraged local farmers to cultivate this vegetable. Chayote belongs to the Cucurbitaceae family and is also known as mirliton, choko, chouchou (Jamaica) and chuchu (Brazil). In this study, chayote leaves and locally produced pineapple fruit were used to develop a fermented smoothie using lactic acid bacteria (LAB) strains; *Lactobacillus plantarum* (L75), *Weissella cibaria* (W64) and their combination (LW64 + 75). The color, total phenols and carotenoid contents of the smoothies fermented for 48 h and stored for 7 days at 4ºC were compared with the unfermented (control) smoothies. A significant reduction of the color change (ΔE) was achieved by LW64+75 compared to a control. As compared with other treatments, L75 increased the level of phenolic content and W64 increased total carotenoid content in smoothies after two days of fermentation. Using an in vitro model simulating gastrointestinal (GI) digestion, fermentation with L75 led to an increase of 65.96% during the intestinal phase compared with the control. In smoothies fermented with L75, LW64+75, W64, and non-fermented smoothies, bioaccessible total phenolic content was 77.15 %, 67.14%, 59.32%, and 52.23%, respectively, in terms of the percentage recovery relative to the total phenolic content in the respective undigested samples. In addition, the antioxidant capacity of the dialyzable fraction of L75 fermented smoothie was significantly higher than that of controls and smoothies fermented with W64 or LW64+75.

Phytochemical composition, antioxidant properties of selected Southern African indigenous fruits

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Phytochemical information about indigenous fruits in the South African food database is lacking, and consumers are seeking healthy foods enriched with antioxidants. Ultra-high performance liquid chromatography-quadrupole time-of-flight mass spectrometry (UHPLC-QTOF-MS) characterised and quantified the untargeted metabolites of 10 indigenous fruits](*Ficus capensis* Thunb (Cape fig), *Landolphia kirkii* (Sand apricot vine), *Engelerophytum magalismontanum* (Transvaal milkplum), *Parinari curatellifolia* (Mobola plum), *Sclerocarya birrea* (Marula), *Strychnos spinosa* (green monkey orange), *Strychnos madagascariensis* (black monkey orange), *Syzgium cordatum* (water berry), *Ximenia caffra* (Sour plum) and *Vangueria infausta* (Wild medlar)] from Limpopo. High-performance liquid chromatography (HPLC-DAD) quantified the carotenoids. Indigenous fruit was classified according to its pulp colour, with three groups of fruit identified, yellow, red, and brown. Red and yellow fruits were high in tryptophan, beta-glucogallin, epicatechin, and catechin. The red fruit group had considerable amounts of quercetin 3-O-α-L-arabinopyranoside and delphinidin-3-galactoside. Gentisic acid 5-O-glucoside was highly concentrated in brown fruit. Yellow fruits were rich in carotenoids. Zeaxanthin (1.60 mg/100 g) was highest in Mobola plum while beta-carotene (1.09) and lutein (10.59) were highest in sand apricot vine. There were three different antioxidant properties assays performed, DPPH, ABTS and FRAP. Mobola plum, Waterberry and Sour plum showed high antioxidant activity. The results indicated these indigenous fruits have a significant phytonutritional value and can be used to develop functional foods or dietary supplements for the food and nutraceutical industries.

Composition of phytochemicals in the leaves of sweet potato varieties (*Ipomoea batatas* L.) from South Africa

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Due to their high level of functionally beneficial compounds, sweet potato leaves have become increasingly popular throughout the world. However, little is known about the sweet potato leaves varieties developed by the ARC, South Africa. In this study, there was a comparison of antioxidant activities (DPPH, ABTS, and FRAP), carotenoids and phenolic compounds in the leaves of locally developed South African varieties (orange fleshed storage roots 'Bophelo,' cream white fleshed 'Monate,' 'Ndou,' 'Blesbok') and the USA's 'Beauregard 'variety and Peru's '1999062.1' variety. Zeaxanthin and β-carotene were most abundant in sweet potato 'Bophelo' leaves, while lutein was highest in 'Blesbok' leaves. The ultra-performance liquid chromatography (UPLC) combined with a time-of-flight mass spectrometer confirmed that all six sweet potato varieties contained different isomers of chlorogenic acid, caffeic acid, quercetin 3-glucosyl-(1->2)-galactoside, quercetin 3-galactoside, rutin, 5-hydroxy-6-methoxycoumarin 7-glucoside, neoeriocitrin and quercetin derivative. Statistical analysis, performed using MetaboAnalyst software 5, determined that the leaves of six different sweet potatoes differed in their concentrations of phenolic metabolites. Using partial least squares discriminant analysis (PLS-DA), hierarchical cluster analysis (HCA) and variables importance in projection (VIP), leaves of six sweet potato varieties were discriminated successfully. The three potential markers, quercetin 3-galactoside, 3,5-dicaffeoyquinic acid and 4,5-dicaffeoyquinic acid, discriminated the 'Beauregard' and 'Ndou' from the rest. On the heat maps, caffeic acid and quercetin derivatives were in highest concentrations in 'Ndou,' whilst neoeriocitrin was highest in 'Blesbok'. The highest antioxidant activity was in the leaves of the local variety 'Bophelo'. The present study provides marketers and consumers with useful information about selecting local sweet potato leaves suitable for cooking.