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Review paper

A Review on Root Crops Processing for Food Security and Health

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ABSTRACT

With a world population of 7.3b, food security and health remains a challenge. There is 6-20% undernourishment in the world. In the South Pacific Islands, 3-14% undernourishment is prevalent. Food deficits exist and $12,669m of products are imported. Moreover, obesity and diabetes are rampant due to globalization and changes in consumption patterns which necessitates for the search of healthy foods. Root crops from taro, cassava, sweet potato and yams are the main sources of 40-50% energy intakes and nutrients. These are good sources of energy, fibre, calcium, iron and vitamins. Root crops supply up to 24% of the energy required and 100% Vitamin C. Root crops are also functional foods and nutraceutical ingredients against chronic diseases helps maintain good health. While world root crop production has increased, the top producers of root crops in the South Pacific are Papua New Guinea, Fiji, Solomon Islands, Vanuatu and Samoa. Food innovations provide modern methods of preserving foods. Food processing for longer continuous supply is a wise alternative. USP is developing processed foods like flour and baked products nutritiously made from natural indigenous ingredients to address Food Security and Health.

KEYWORDS: Root Crops, Food Security, Health, Food Processing, Food Innovation

INTRODUCTION

With a world population of 7.3b, is there food enough for all? For the next decades, food security and health remains a challenge. Hence, food availability (sufficient food), stability (steady supply of food), utilization of food resources and access (obtainable food) should be optimized without compromising natural resources. National policies and USP efforts towards food security are geared towards providing healthy processed food from indigenous resources.

There is 6-20% undernourishment prevalent in the world. In the South Pacific Islands, 3-14% undernourishment and up to 88% food deficits exist. In fact, in urban areas there is higher percentage of undernourished in Samoa. While obesity and diabetes are main problems due to globalization and changes in consumption patterns which necessitates search for healthy foods. There is mostly more food importation than exportation where $12,669m products are imported in Oceania (FAO 2015).

Root and tuber crops are grown all over the world and are very important crops in the Pacific Islands. A 40-50% energy are sourced out from taro, cassava, sweet potato and yams. Taro is the staple food in Samoa and Solomon Islands but in Fiji is cassava. Sweet potato and yams are also heavily utilized in the Pacific islands. Root crop production is increasing, with top producers of root crops in the South Pacific being Papua New Guinea, Fiji, Solomon Islands, Vanuatu and Samoa (FAO 2015). In Samoa, there was a decrease of GDP due to more underutilized areas for agriculture and more importation than exportation. The production of taro, yam, ta'amu increased with price (Samoa Bureau of Statistics 2018). Taro is being exported to various countries such as New Zealand, Australia and USA (Ministry of Agriculture in Samoa 2017). While in Fiji, taro and yam price increased with decreased production and cassava price remained steady with increased production. Taro is the main root crop exported from Fiji as of 2014 (Fiji Bureau of Statistics 2016).

Root crops are important sources of energy and nutrients. These are also good sources of fibre, calcium, iron, vitamins and minerals. Food innovations provide modern methods of preserving foods. Food processing for longer continuous supply is a wise alternative. It is indeed vital to develop instant foods that are healthy and made from available natural ingredients.

Food Security in the World and South Pacific

With a world population of 7.3b, food security and nutrition remains a challenge. Undernourishment means the state of inability to acquire enough food that lasts for a year. It is also defined as a condition of taking food which is still not enough to satisfy the required dietary energy. Sufficient food is vital for living an active and healthy life. Yet, over one in every nine people out of 793 million people in the world still lack sufficient food. Progress has been anticipated despite significant population growth. More suffer from undernourishment about two hundred and eighteen million fewer people than 25 years ago and 169 million fewer than a decade ago. Africa with the highest population of 1,138m got the most percentage of undernourishment with 20% as of 2014. Asia ranked second in population of 4,342m, followed by Latin America with 623m and Oceania with 10m. While second highest % undernourishment was in Oceania (14%), followed by Asia (12%) and Latin America (6%).

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In the South Pacific as of 2017, highest population was Papua New Guinea (7,945,690), followed by Fiji (902,930), Solomon Islands (608,140), Vanuatu (275,603), Samoa (195,870), Kiribati (108,550), Tonga (107,820) and Cook Islands (20,780). Percentage of undernourishment was high in Solomon Islands (13.9%) and Vanuatu (6.9%) compared to Fiji (4.6%), Kiribati (3.3%) and Samoa (3%).

There is more total food importation ($966,964m) than exportation ($945,572m) worldwide. For instance, Asia had $325,015m food imports over $181,141m food exports. In Africa, there is $70,074m food imports over $28,015m food exports. However, Latin America and Oceania had more food exports over food imports with $142,567m and $45,536m exports and $67,602m and $12,669m imports, respectively.

Food availability is an integral part of attaining food security. Supply of enough food to majority is inevitable, but still insufficient; assuring food access for very person. Previous decades, the production of food per capita have been generally progressive in all most regions. However, in Africa growth rates lowered for the preceding 20 years, even with extraordinary allowances. Occasionally, when available food is high there is comparatively low incidence of hunger. Yet, outcome gages may show that high available food does not at all times warrant great food security.

The food production value ($/person) was also highest in Papua New Guinea ($331/person), Tonga ($306/person) and Vanuatu ($303/person) than in Samoa ($268/person), Fiji ($222/person), Solomon Islands ($210/person), Kiribati ($127/person) and Cook Islands ($112/person). The energy supply (%) was highest in Kiribati (139%) followed by Vanuatu and Samoa (129%), Fiji (123%), Solomon Islands (111%) and Papua New Guinea (101%). While Solomon Islands had the highest food deficit of 88 kcal/capita/day followed by Vanuatu (44), Fiji (31), Samoa and Kiribati (20) (FAO 2015).

Root Crop Production in the World and South Pacific

Root and tuber crops are extensively produced everywhere the world and are especially imperative in the Pacific Islands. Regardless of a rising need on imported flour and rice products in the Pacific, root crops such as taro (*Colocasia esculenta*), giant swamp taro (*Cyrtosperma murkessi*, giant taro (*Alocasia macrorhhiza*), tannia (*Xanthosoma sagittifolium*), cassava (*Manihot esculenta*), sweet potato (*Ipomoea batatas*) and yams (*Dioscorea spp.*) persist critically central components of many Pacific Island diets, predominantly for the large rural inhabitants that quiet prevail in many PICTs. The 40-50% energy consumptions are from taro, cassava, sweet potato and yams. Taro is consumed as an essential food in Samoa and Solomon Islands while cassava is a main food in Fiji. Sweet potato and yams are also utilized in the Pacific islands.

Colocasia taro, one of the supreme and widespread root crops in the region, has become a pillar of most Pacific Island cultures. As highly regarded crop, it is usually prepared for traditional feasts, gifts and pleasing social commitments in many PICTs. Yams, giant taro and giant swamp taro, though not much eaten, are also culturally and nutritionally vital in some PICTs and have occupied an important use for food security in the region. Tannia, cassava and sweet potato are comparatively newcomers to the Pacific region but have quickly enlarged traction among some growers due to their relative ease of establishment and cultivation, and resilience to pests, disease and drought.

Root and tuber crops are food of over one billion people with annual production assessed at 795 million tonnes. The Pacific intake of root crops is 200kg/capita/year. These are the most essential staples and carbohydrate source for Pacific Island Countries and are foundation for food security, income and livelihood even with rigid competition with rice and flour. They are also valued for animal feed and industrial products and are easy to produce and care. Root crops have extensive agro-ecological adaptability which can be cultivated in marginal lands, underneath mixed-crop farming system and below ground. Most root crops are tolerant to cyclones and resistant to mid-season drought (Pacific Root Crops-FAO 2018).

The world root crop production is growing. Root and tuber crop production index (calculated based on Laspeyres formula) increased from 74 in 1990 to 119 in 2014. The highest index in root and tuber crop production was Africa (133) followed by Asia (129) and Oceania (110).

Top producers of root and tuber crops in the South Pacific are Papua New Guinea, Fiji, Solomon Islands, Vanuatu and Samoa as of 2014. Root and tuber crop production index increased from 1990 to 2014 in Fiji and Solomon Islands while it decreased in Samoa and Vanuatu (FAO 2015).

In Fiji, taro price increased with decreased production (Fiji Bureau of Statistics 2016). Taro produced in 2013 amounted to 133,310t but decreased to 62,748t in 2014 as the priced increased from FJD1,000/t to FJD1,500/t. Cassava price remained steady with increased production from 74,239 tonnes (2013) to 77,721 tonnes (2014) at FJD800/t. For yam, price decreased from FJD1,500/t (2013) to FJD1,000/t (2014) with increased production from 4,976t (2013) to 5,474t (2014). Kumala price remained steady at FJD500/t with 8,546t (2013) and 8,581t (2014) production.

Taro is the main root crop exported and ranked ninth in terms of amount (FJD25m) in Fiji's principal domestic exports as of 2014. Sugar tops exports amounting to FJD200m, followed by mineral water (FJD190m),

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garment (FJD100m), gold (FJD90m), woodchips (FJD50m), timber, cork & wood (FJD49m), fresh fruits and vegetables (FJD48m), fresh fish (FJD47m) and preserved fish (FJD24m).

In Samoa, there was a decrease of GDP with more underutilized areas for agriculture (Samoa Bureau of Statistics 2013). There was more importation than exportation of agriculture and forestry products in Samoa in 2014 with 17.8% imports over 1.25% exports (www.spc.int/nmdi). There were 58 crops identified for Samoa (Samoa Bureau of Statistics 2004; 2015). Some of these are: tree crops (coconut, breadfruit, banana, avocado, cocoa, coffee, grape fruit, mango, mangosteen, papaya, mandarin, orange, lemon, lime, soursop, star fruit, durian etc.); vegetables (tomatoes, Chinese & English cabbage, capsicum, chillies, cucumber, pumpkin, okra, eggplant, zucchini, cauliflower, celery, etc.); root crops (taro, yam, ta'amu, taro palagi, sweet potato, cassava, etc.), and other crops (turmeric, vanilla, black pepper, sweet corn, peanut, etc.). Root and tuber crops are the best food security assurance for Samoa and the Pacific.

The production of taro and yam increased with price at the end of January 2018 (Samoa Bureau of Statistics 2018). Taro production amounted to 13t in volume which costs T4/kg as of January 2018 from 6t and cost of T2/kg in December 2017. Yam produced in January 2018 amounted to 200kg in volume which costs T2.50/kg compared to 125kg which costs T1.5/kg in December 2017. While Ta'amu price increased with decreased production from 800kg, which cost T5/kg in December 2017 to 390kg which cost T6/kg in January 2018.

Taro is being exported to various countries such as New Zealand, Australia and USA (Ministry of Agriculture in Samoa 2017). As much as 931t of fresh taro and 37t of frozen taro have been exported at the second quarter of 2017.

While Pacific root crops are cultured generally for domestic use in gardens and smallholdings, roughly international trade of root crops is manifested with Australian and New Zealand and, to a smaller amount, North America. While there is great opportunity to expand these and other international trade markets, efforts are also necessary to uphold and start intraregional trade of root crops among nearby Pacific Islands. Such trade has the potential to advance regional food security and to generate livelihood prospects within Pacific Island agricultural sectors (Pacific Root Crops 2018).

Nutritional Value of Root Crops

To lessen food security and poverty in Samoa and the South Pacific, root crops are well-thought-out as the most chief sources for energy. The 70% of energy requirement in the diet comes from carbohydrates while the other 30% sources are protein, vitamins and minerals. The energy in the diet sourced from imported rice and flour, can simply be replaced by the root crops, banana and breadfruit. Samoa has the prospect to develop the local energy food crops by processing of local products from taro, banana, breadfruit, and taro palagi. This will increase sources of cash income and lessen post-harvest losses.

Taro is of vital component among root crops as main sources of energy and nutrients in Tonga and the Solomon Islands. The taro tuber (corm) is a great source of both energy and fibre and, when consumed regularly, provides ample amounts of calcium and iron. Sweet potatoes and yams are also sufficient sources of energy, which the body requires to stay energetic. The yellow and orange varieties of the sweet potato root comprise a high amount of Vitamin A and all varieties contain considerable quantities of Vitamin C. Yams provide substantial amounts of vitamin B1, vitamin C and dietary iron and niacin. Some Pacific root crops such as sweet potato, taro and cassava have leaves that are also edible and nutritious. For instance, taro leaves are an outstanding source of protein, dietary fibre and various vitamins and minerals including carotene, potassium, calcium, phosphorous, iron, riboflavin, thiamine, niacin, vitamin A and vitamin C (Pacific Root Crops 2018).

Taro corm is a great source of carbohydrates and potassium as well. Huge portions of taro corms can be converted to a sufficient source of dietary protein, particularly if eaten many times daily. Taro also contains thiamin, riboflavin, iron, phosphorus and zinc and are good sources of vitamin B6, vitamin C, niacin, potassium, copper and manganese. Taro has greater quantities of vitamin B-complex than whole milk (Soudy et al. 2010). The 36 samples of mature taro from 22 cultivars was studied for their compositions. For most nutrients, there was a large range in proximate composition between cultivars; for instance, water ranged from 55.8 to 74.4 g 100 g−1, starch 20.0 to 35.1 g 100 g−1 protein 0.5 to 2.1 g 100 g−1, dietary fibre 1.4 to 5.4 g 100 g−1 and energy 403 to 672 kJ 100 g−1 (Wills et al. 1983).

The leaves of sweet potato provide huge portions of protein, having great amino acid score. All parts of sweet potato are abundant in dietary fibre, the leaves in particular are soluble dietary fibre and stems are insoluble dietary fibre, respectively. The mineral content like iron and vitamins such as carotene, vitamin B2, vitamin C and vitamin E are rich in leaves in contrast with other vegetables. Furthermore, leaves has reasonably more polyphenol content (Hiroshi et al. 2000).

Potatoes and yams have huge quantities of proteins compare to other tubers. The limiting ones in root crop proteins are Sulphur-containing amino acids, that is, methionine and cystine. Cassava, sweet potatoes, potatoes, and yam may have more or less vitamin C while yellow varieties of sweet potatoes, yam, and

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cassava comprise of β-carotene. Taro also contain big amount of potassium. Roots and tubers maybe deficient in most other vitamins and minerals but comprise substantial amounts of dietary fibre (FAO 1990).

Taro and tannia are sources of 393kj energy/100g, protein (2.2g), fat (0.4g), carbohydrate (21g), and fibre (0.8g). It is high in potassium, calcium and phosphorus, and contains sodium, iron, vitamin C, thiamin, riboflavin, and niacin. Taro leaves provide 255kj energy/100g, protein (4g), and carbohydrate (11.9g). It is high in calcium, phosphorus, potassium, carotene, folic acid and vitamin C. It also contains iron, thiamin, riboflavin, and niacin (FAO, 1972).

Raw sweet potatoes comprise of 86 kcal energy/100g, protein (1.6g), fat (0.1g), carbohydrate (20.1g), fibre (3g), sugar (4.2g). It is high in potassium, calcium, magnesium, phosphorus, sodium and vitamin A and provides vitamins such as vitamin C, thiamin, riboflavin, niacin, vitamin B6, folate, vitamin E, and K (USDA 2015). Sweet potato tips also have 2.7g protein/100g. It is high in iron, calcium, carotene, and vitamin C (FAO, 1972).

Raw sweet cassava provides 160 kcal/100g, protein (1.4g), fat (0.3g), carbohydrate (38.1g), fiber (1.8g), sugar (1.7g). It has huge amounts of potassium, phosphorus and vitamin C and contains minerals and vitamins such as calcium, magnesium, sodium, vitamin A, thiamin, riboflavin, niacin, vitamin B6, folate, vitamin E, and K (USDA 2015).

Raw yam comprises 118 kcal energy/100g, protein (1.5g), fat (0.2g), carbohydrate (27.9 g), fibre (4.1g), sugar (0.5g). It is high in potassium, phosphorus and vitamin A and has minerals and vitamins such as calcium, magnesium, sodium, vitamin C, thiamin, riboflavin, niacin, vitamin B6, folate, vitamin E, and K (USDA 2015).

Root crops are rich sources of energy, fibre, protein, calcium, iron, vitamins A, C, B1, B2, and nicotinic acid (FAO 1972). Root crops supply up to 24% of the energy requirement and 100% of vitamin C.

Health Benefits of Root Crops

Health is treasure. Yet globalization, increased flow of goods and services comes with obesity, overweight and diabetes. Hence, there is a quest for nutritious and superfoods that offers wellness.

Starchy roots and tuber crops provides numerous desirable nutritional and health benefits such as antioxidative, hypoglycemic, hypocholesterolemic, antimicrobial, and immunomodulatory activities. Many bioactive constituents such as phenolic compounds, saponins, bioactive proteins, glycoalkaloids, and phytic acids are accountable for the perceived effects (Chandrasekara and Kumar, 2016).

Sweet potatoes are abundant in dietary fibre, minerals, vitamins, and bioactive compounds such as phenolic acids and anthocyanins, which also give to the color of the flesh. A 125g orange fleshed sweet potatoes, rich in carotenoids, improves vitamin A status of children, particularly in unindustrialized nations (van Jaarsveld, et al. 2006). Carotenoids possess copious bioactivities and act vital functions in human health and nutrition, containing provitamin A activity, antioxidant activity, regulation of gene expression, and induction of cell-to-cell communication for well-being benefits (Tapiero, et al. 2004).

Sporamin in sweet potato indicated various antioxidant activities related to stress tolerance, such as DHA and MDA reductase activities (Hou and Lin, 1997). Purple sweet potato is a potential agent, which can prevent obesity. Anthocyanin fraction may increase high fat diet induced fatty liver disease and control hepatic lipid metabolism (Hwang et al. 2011). Differentiation and proliferation inhibitory activity of sporamin of sweet potato roots in 3T3-L1 preadipocytes were reported (Zhi-Dong, et al. 2009).

The phytochemicals present in sweet potato roots may exert a substantial effect on antioxidant and anticancer activities which is directly correlated to the phenolics and flavonoid quantities of the sweet potato extracts. Phytochemicals contribute greatly to the potent antioxidant activity and antiproliferative activity *in vitro* (Huang, et al. 2004). Extracts of sweet potato peels have revealed reduced plasma glucose levels of diabetic patients (Ludvik, et al. 2002).

Cassava roots contain a number of bioactive compounds, namely, cyanogenic glucosides such as linamarin and lotaustralin, noncyanogenic glucosides, hydroxycoumarins such as scopoletin, terpenoids, and flavonoids (Blagbrough, et al. 2010; Prawat, et al. 1995; Reilly, et al. 2004). Bioactive compounds in plants are secondary metabolites having pharmacological or toxicological effects in humans and animals. Phenolics present in tubers render several health benefits, explicitly, antibacterial, anti-inflammatory, and antimutagenic activities, among others (Chandrasekara and Kumar, 2016).

Yam tubers contain various bioactive components, specifically, mucin, dioscin, dioscorin, allantoin, choline, polyphenols, diosgenin, and vitamins such as carotenoids and tocopherols (Iwu, et al. 1990; Bhandari et al. 2003). Mucilage of yam tuber provides soluble glycoprotein and dietary fibre. Several studies have indicated hypoglycemic, antimicrobial, and antioxidant activities of yam extracts (Kelmason, et al. 2000; Chan, et al. 2004). Yams may stimulate the proliferation of gastric epithelial cells and enhance digestive enzyme activities in the small intestine (Chen, et al. 2003). Purified dioscorin from yam tubers showed immunomodulatory activities in vitro (Liu, et al. 2007).

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Yam (Dioscorea) has the potential to reduce the risk of cancer and cardiovascular diseases in postmenopausal women (Wu, et al. 2005). Ethanolic extract of tubers of *Dioscorea alata* exhibited an anti-diabetic activity in alloxan-induced diabetic rats (Maithili, et al. 2011). Diosgenin, a steroidal saponin of yam (Dioscorea), demonstrated antioxidative and hypolipidemic effects *in vivo* (Son, et al. 2007). Chronic administration of Dioscorea may improve bone strength and afford insight into the role of Dioscorea in bone remodeling and osteoporosis during the menopause (Chen, et al. 2008).

Root crops are loaded with nutrients, vitamins and minerals that make the body fit. It provides high fibre that lowers blood cholesterol, prevents constipation, control blood sugar level, delays emptying of the stomach to help us feel full longer, enhances weight control and prevents diabetes. Cassava boosts energy level, ensures healthy weight gain, helps prevent Alzheimer's disease and cardiovascular diseases, and useful for muscle growth and development maintaining optimal blood pressure. Sweet potato also increases energy level and immune system, for healthy weight gain, maintains water balance in the body, cures stomach ulcers and inflammation, relieves arthritis and bronchitis, and helpful in curing cancer. Taro lowers risks of developing diabetes, reduces risks of lung and oral cancer, valuable in enhancing cognitive function, helps prevent anemia and boosts blood circulation, prevents excess gas, bloating, cramping, and constipation, helps relieves stress and pressure on blood vessels and arteries, boosts vision and reduces risk of macular degeneration or cataracts. Yams contain lower glycemic index, reduce constipation, lower bad cholesterol, and prevents colon cancer (organicfacts.net).

Value-Adding and Processing Root crops

Most kinds of root crops can be stored in the field or left in the ground to grow, for wavering lengths of time until they are needed for consumption. The time to store maybe delayed from a few months to many years in the case of Cytosperma; Giant swamp taro. Even though other root crops, such as Colocasia taro, can deteriorate easily after harvesting, field storage is still the best option for staying root crops fresh. When field storage is not practical, there are other traditional ways of preservation that can be utilized to extend the shelf life of root crops. One specific method is keeping the tuber underground in purpose-built pits lined with coconut husks or banana leaves that are then covered with soil. The tubers may be stored for up 2 to 3 months in this procedure. It is likewise probable to bake the tubers in a hot earth oven until an external crust is made. The tubers can then be kept for up to a week or more before consumption. Otherwise, they can be conserved by parboiling the root, slicing it thinly and then sun-drying the tuber slices. Taro root preserved in this technique will stay up to several months when kept in a tightly sealed jar, tin or plastic bag.

In Hawaii and Tahiti, taro is also kept as poi – a food that is usually eaten every traditional feasts. Poi is prepared from Colocasia taro that has been steamed in an earth oven. The taro is peeled and then pounded on a flat stone or a special wooden bowl (kumete) to produce a paste-like texture. Throughout the process of pounding, a lesser quantity of water is added to attain the best consistency of the mixture to form the poi. It can then be consumed fresh, kept overnight to mature (ferment) for flavour, or conserved for several weeks before being eaten. The use of freezers over the Pacific region has apparently delivered a modern way of preserving root crops for long-term storage. Peeling and freezing of root crops offer convenient storage for several months and is gradually used by Pacific agricultural exporters to avoid strict quarantine requirements enforced by developed trading partners (Pacific Root Crops 2018).

Processing taro corm pointedly reduced its proximate composition, mineral content, phytochemical components and antinutrient (oxalate and phytate) contents when taro corms were converted into powder. These is further lessened when processed into taro noodles and cookies. Exposure to high temperature during processing significantly affected the reduction in nutrient and phytochemical as well as antinutrient contents of raw taro (Alcantara et al. 2013).

Root crops are exploited in various ways such as Root crop flour, Pancakes, Biscuits, Baki cakes, Sweet potato buns, Roti, Taro cakes, Taro muffins, Sweet potato biscuits, Steamed cassava snacks, Spicy cassava cake, Fritters, Chocolate sweet potato pie, Honey bread, Cassava snacks, Cassava bread, Banana bread, Vanilla buns, Mixed flour bread, Root crop starch, Caramel dessert, Savoury griddle cakes, Iced dessert (ice-cream), Sweet potato jam, Cassava drops, Sweet potato mash, Vakalavalava, Savoury balls, Sweet potato cake, Chips, French fries, Sweet potato soufflé, Taro fish cakes, Sweet potato pudding, Spicy sweet potato cake, and Sweet potato bread (FAO, 2018).

Those fermented foods from cassava consist of gari, fufu, lafun, chick-wanghe, agbelima, attieke, and kivunde in Africa, tapein in Asia, and "cheese" bread and "coated peanut" in Latin America (Ray and Sivakumar, 2009). Sweet potatoes also may be fermented into soy sauce, vinegar, lactojuices, lactopickles, and sochu (an alcoholic drink produced in Japan), and yams may be made into fermented flour. Greater yams (*Dioscorea alata* L.), frequently called as ube in the Philippines, are consumed as sweetened food delicacies due to their attractive violet color and unique taste. Ube is utilized in a number of native delicacies such as halaya (yam pudding with milk), sagobe (with parboiled chocomilk and glutinous rice balls), puto (rice cake), halo-halo, hopia, and different types of rice cake using glutinous rice such as suman, sapin-sapin, bitso, and bibingka. It can also be made as an ingredient for flavor and/or filling in ice cream, tarts, bread, and cakes (Chandrasekara and Kumar, 2016).

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The USP – Alafua Food Technology Laboratory is fully equipped for product development. Root crops such as cassava, sweet potato, yams and taro can be processed into various products such as flour, powder, chips, ice cream, polvoron, candy, biscuits, cake, cookies, bread and other steamed and baked products. Hence, it has great potential for utilization and commercialization.

The USP – Alafua Food Technology have developed various products from indigenous crops such as breadfruit, taro, cassava, sweet potato, lemon grass, moringa, basil, oregano, papaya, etc. These are Flour, Powder, Cookies, Pan cake mix, Polvoron, Chips, Green Tea, Dried fruit, Juice, Jams, Marmalade, Syrup, Ketchup, Dips, Pickles and many more. Addressing Food Security and Health through Food Innovation from organic and natural ingredients is one of the thrust of the University of the South Pacific.

CONCLUSION

Root and tuber crops are the best food security assurance for Samoa and the Pacific; considering that 6-20% in the world and 3-14% in the South Pacific Islands are undernourished. While food deficit prevails and more products are imported, malnutrition and obesity still exists.

Root crops such as taro, cassava, sweet potato and yam are main sources of energy and nutrients with 40-50% energy source. These are also excellent sources of fibre, calcium, iron and vitamins. Root crops supply up to 24% of the energy requirement and 100% of vitamin C. Root crops are also functional foods and nutraceutical ingredients to prevent non-communicable chronic diseases and maintain good health. Processing foods like flour and baked products nutritiously made from natural indigenous ingredients to address Food Security and Health is a wise alternative.

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