University of the Philippines Manila
College of Medicine

Therapeutics 202

YACON:
Reviewing the Evidence

Submitted by:
Brillantes JNM, Buenafe FMA, Cabrera N, Calderon J, Campos E,
Canoy IC, Capili C, Carasco MAA, Cielo PM, Co ML, Collantes PA,
Concepcion FA, Concha JS, de Vera AS, de Vera RJ, del Rosario KA

INTRODUCTION

Yacon (*Smallanthus sonchifolius*, Asterecae) is a perennial herb growing 1.5 to 3 meters tall (Park *et al.* 2009). Aside from its aerial stems and leaves, it forms 4 to 20 edible fleshy large tuberous roots. The tuber is composed of water, fructooligosaccharides, proteins, minerals and polyphenols.

Up to 67% of the yacon tuber is made of fructooligosaccharides, which help give the tuber its sweet flavor (Taylor 2006). However, these sugars are not readily digested or metabolized by humans, which is why yacon shows great promise as food for diabetics.

Thus, yacon was said to have a potential benefit in the management of diabetes.

SEARCH STRATEGY #1

The group searched PubMed, Herdin, and The Cochrane Library for studies on Yacon and its possible effects in diabetes. The following search terms were used:

- Yacon
- *Smallanthus sonchifolius*
- *Smallantus sonchifolius*
- Diabetes mellitus
- Diabetes
- Glucose metabolism

The search terms Yacon, *Smallanthus sonchifolius* and a variant of the spelling of the scientific name were combined using the Boolean operator "OR", and the search yielded 35 results. Next, the terms Diabetes Mellitus, Diabetes, and Glucose Metabolism were used, and 538,839 results were obtained. Finally, after combining the search terms for Yacon and for Diabetes using the Boolean operator "AND", only eight articles were left. (see Figure 1)

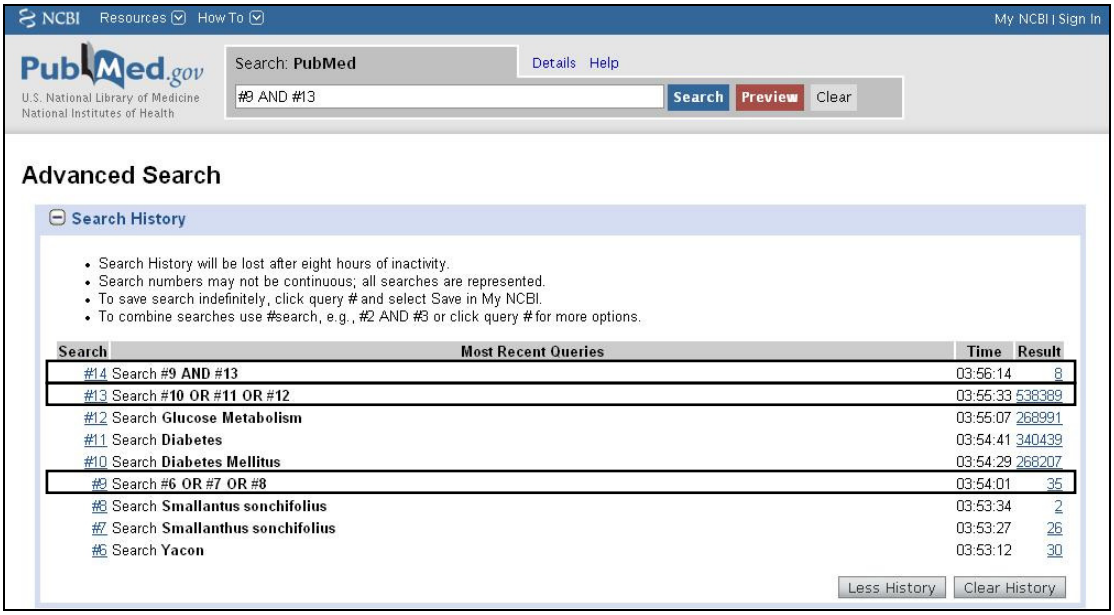

Figure 1. PubMed search results

The same search terms were used in Herdin. It yielded only one result. (see Figure 2)

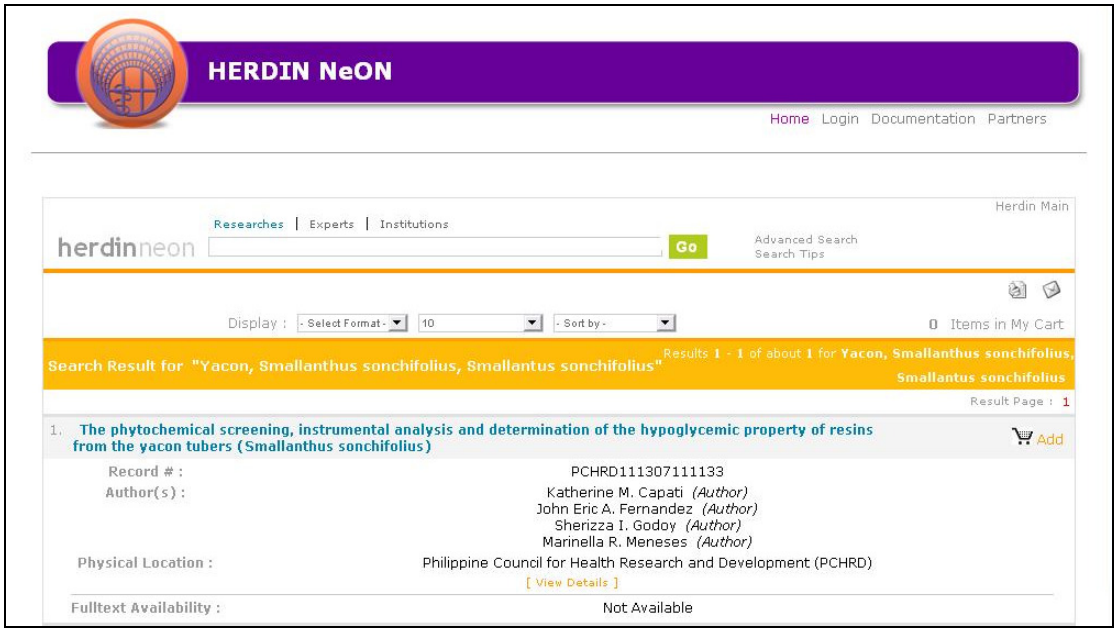

Figure 2. Herdin search results

In The Cochrane Library, the related literature on Yacon and Diabetes was the same as that found in PubMed. (see Figure 3)

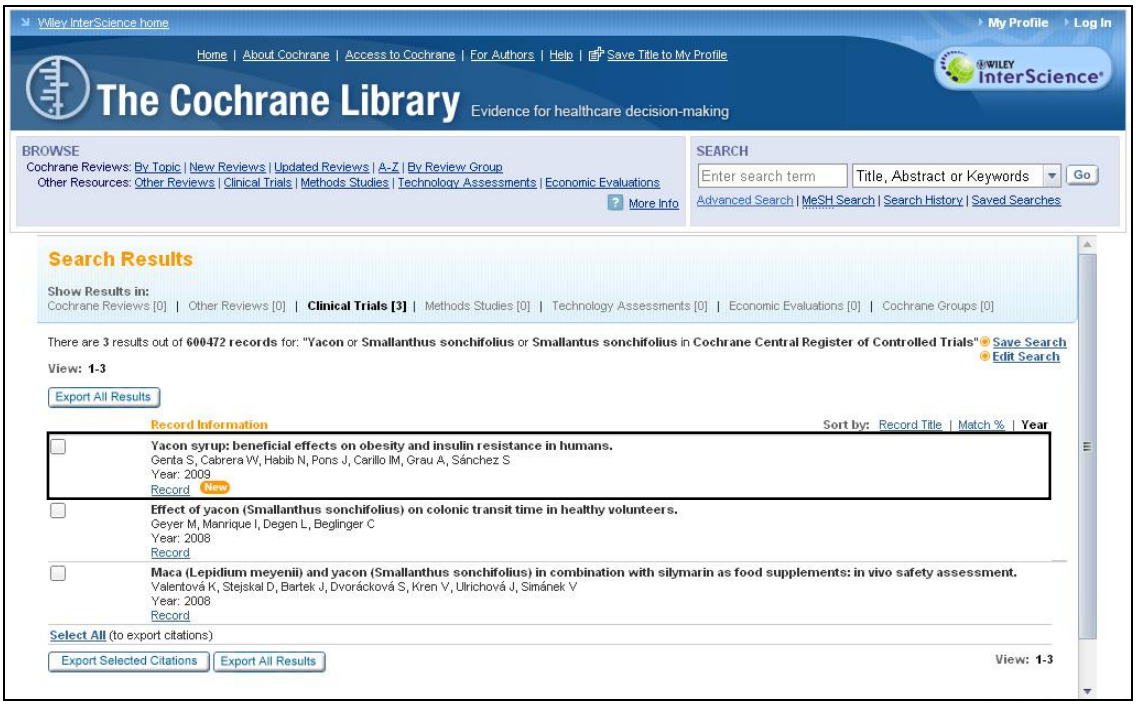

Figure 3. The Cochrane Library search results

SUMMARY OF FINDINGS (Search #1)

The following studies regarding the use of yacon in diabetes were found, and the abstract of the said articles were reviewed (see Appendix):

1. Genta SB, et al. Yacon syrup: beneficial effects on obesity and insulin resistance in humans. Clin Nutr. 2009 Apr;28(2):182-7. Epub 2009 Feb 28.
2. Valentová K, et al. Induction of glucokinase mRNA by dietary phenolic compounds in rat liver cells in vitro. J Agric Food Chem. 2007 Sep 19;55(19):7726-31. Epub 2007 Aug 23.
3. Neves VA and da Silva MA. Polyphenol oxidase from yacon roots (Smallanthus sonchifolius). J Agric Food Chem. 2007 Mar 21;55(6):2424-30. Epub 2007 Feb 23.
4. Terada S, et al. Constituents relating to anti-oxidative and alpha-glucosidase inhibitory activities in Yacon aerial part extract. Yakugaku Zasshi. 2006 Aug;126(8):665-9.
5. Genta SB, et al. Subchronic 4-month oral toxicity study of dried Smallanthus sonchifolius (yacon) roots as a diet supplement in rats. Food Chem Toxicol. 2005 Nov;43(11):1657-65.
6. Valentová K, et al. The effect of Smallanthus sonchifolius leaf extracts on rat hepatic metabolism. Cell Biol Toxicol. 2004 Mar;20(2):109-20.
7. Matsuura T, et al. Suppression of glucose absorption by various health teas in rats. Yakugaku Zasshi. 2004 Apr;124(4):217-23.
8. Aybar MJ, et al. Hypoglycemic effect of the water extract of Smallantus sonchifolius (yacon) leaves in normal and diabetic rats. J Ethnopharmacol. 2001 Feb;74(2):125-32.
9. Capati KM, et al. The phytochemical screening, instrumental analysis and determination of the hypoglycemic property of resins from the yacon tubers (Smallanthus sonchifolius).

In the studies, parts of the herb used were basically extracted forms of either the yacon roots/tubers or the aerial part of the plant (mostly the leaves). Only 1 out of the 9 studies reported results of a randomized control trial, which was conducted among obese and slightly dyslipidemic pre-menopausal women. This study has a level of evidence of 1B. The rest were done in vitro or in rats, having a level of evidence of 5. (see Table 1)

Table 1. Summary of findings of studies on yacon and its use in diabetes

#	Part of Herb Used	Type of Study	Level of Evidence
1	Yacon roots → syrup	RCT: obese & slightly dyslipidemic pre-menopausal women, double-blind, placebo-controlled	1B
2	Yacon → phenolic acids & extracts	In vitro: rat hepatocytes, rat hepatoma Fao cells	5
3	Yacon roots → polyphenol oxidase	In vitro	5
4	Yacon aerial part → water extract	In vitro: rat brain homogenate	5
5	Yacon root → flour	Animal study: rats	5
6	Yacon leaves → extracts	In vitro: rat hepatocytes	5
7	Yacon → tea	Animal study: rats	5
8	Yacon leaves → water extract	Animal study: rats	5
9	Yacon tubers → extracts	Animal study: rabbit	5

The results and conclusions of the studies are as follows:

Table 2. Results/conclusions of studies on yacon and its use in diabetes

#	Results/Conclusions
1	Daily intake of yacon syrup produced a significant decrease in body weight, waist circumference BMI; Decrease in fasting serum insulin was observed; Fasting glucose and serum lipids were not affected by syrup treatment and the only positive effect was found in serum LDL-cholesterol levels. Long-term consumption produced beneficial health effects on obese pre-menopausal women with insulin resistance.
2	Phenolics lowered glucose production compared to metformin; Increased the level of glucokinase mRNA in the same way as insulin
3	Sucrose, maltose, glucose, fructose, and trehalose at high concentrations appeared to protect yacon PPO against thermal inactivation at 75 and 80° C.
4	Aerial part of yacon has strong antioxidative activity
5	No hypoglycemic activity in normal rats; Significantly reduced post-prandial serum triacylglycerol levels
6	Exhibited strong protective effect against oxidative damage; Reduced hepatic glucose production; Effects on CYP2B and CYP2E mRNA expression comparable to insulin
7	No significant effect in influencing glucose absorption
8	Produces an increase in plasma insulin concentration
9	Exhibited glucose lowering activity within 5-10 h, but blood glucose level increased again after 24 h

In summary, the studies that tested the aerial part and leaf extracts, and phenolics of yacon, consistently reported lowering of glucose production, mRNA expression similar to that of insulin, and exhibition of strong anti-oxidative activity. On the other hand, results regarding the glucose lowering activity provided by root/tuber extracts of yacon are variable – from no effect on hypoglycemic activity to having some effect. However, the studies show a reduction in serum LDL-cholesterol and triglyceride levels. Also, it was concluded from the RCT that long-term consumption of yacon syrup produced beneficial health effects on obese pre-menopausal women with insulin resistance. (see Table 2)

SEARCH STRATEGY #2

In our review of articles regarding yacon and its use in diabetes, we found out that the herb seems to have other benefits, i.e. its anti-oxidative activity. The group then decided to manually filter the PubMed results obtained using the yacon terms to check if yacon has other potential uses. (see Figure 1)

Out of the 35 articles, six reported other potential benefits of yacon aside from affecting glucose metabolism. These include anti-oxidant and anti-microbial activities, and others. The rest of the articles discussed the composition of yacon, and processing and extraction procedures of the plant, topics which are not of the group's interest as of the moment.

SUMMARY OF FINDINGS (Search #2)

The following studies regarding other potential uses of yacon were found, and the abstract of the said articles were reviewed (see Appendix):

1. Terada S, et al. Constituents relating to anti-oxidative and alpha-glucosidase inhibitory activities in Yacon aerial part extract. Yakugaku Zasshi. 2006 Aug;126(8):665-9.
2. Valentová K, et al. The effect of Smallanthus sonchifolius leaf extracts on rat hepatic metabolism. Cell Biol Toxicol. 2004 Mar;20(2):109-20
3. Valentová K, et al. Radical scavenging and anti-lipoperoxidative activities of Smallanthus sonchifolius leaf extracts. J Agric Food Chem. 2005 Jul 13;53(14):5577-82.
4. Lin F, et al. Purification and identification of antimicrobial sesquiterpene lactones from yacon (Smallanthus sonchifolius) leaves. Biosci Biotechnol Biochem. 2003 Oct;67(10):2154-9.
5. Geyer M, et al. Effect of yacon (Smallanthus sonchifolius) on colonic transit time in healthy volunteers. Digestion. 2008;78(1):30-3. Epub 2008 Sep 10.
6. Lobo AR et al. Effects of fructans-containing yacon (Smallanthus sonchifolius Poepp and Endl.) flour on caecum mucosal morphometry, calcium and magnesium balance, and bone calcium retention in growing rats. Br J Nutr. 2007 Apr;97(4):776-85.

Again, parts of the herb used were extracts from yacon roots and leaves. All except one study have a level of evidence of 5. The studies were either cell- or animal-based. The other one was a randomized, double-blind, placebo-controlled study wherein yacon was administered among healthy individuals. (Table 3)

Table 3. Summary of findings of studies on yacon and its other potential uses

#	Part of Herb Used	Type of Study	Level of Evidence
Anti-oxidant			
1	Yacon aerial part → water extract	In vitro: rat brain homogenate	5
2	Yacon leaves → extracts	In vitro: rat hepatocytes	5
3	Yacon leaves → water extract	In vitro: rat hepatocytes	5
Anti-microbial			
4	Yacon leaves → extract	In vitro: rats	5
Others			
5	Yacon roots → syrup	RCT: healthy individuals, double-blind, placebo-controlled	1B
6	Yacon roots → flour	Animal study: rats	5

The results and conclusions of the studies are as follows:

Table 4. Results/conclusions of studies on yacon and its other potential uses

#	Results/Conclusions
Anti-oxidant	
1	Aerial part of yacon has strong antioxidative activity
2	Exhibited strong protective effect against oxidative damage
3	Exhibited scavenging and anti-lipoperoxidative activities; Retardation of free radical formation Good candidate for use as a food supplement in the prevention of chronic diseases involving oxidative stress.
Anti-microbial	
4	Sesquiterpene lactones from yacon leaf extracts exhibited potent anti-microbial activity against Bacillus subtilis and Pyriculia oryzae
Others	
5	Yacon markedly accelerates colonic transit in healthy individuals Root can be useful treatment in constipated diabetic or obese patients due to its low caloric content
6	Positive Ca and Mg balance; Higher values of bone mineral retention and biomechanical properties; Increase in depth and number of total and bifurcated crypts

In summary, leaf and aerial part extracts of yacon showed strong anti-oxidative activity, consistently seen in level 5 studies, as well as potent anti-microbial activity against Bacillus subtilis and Pyriculia oryzae. Yacon root extracts also seem to have an effect in the gastrointestinal tract. It markedly accelerates colonic transit in healthy individuals, thus the root may be a useful treatment for constipated patients. It also has positive effects on mineral intestinal absorption, bone mass and biomechanical properties, making yacon roots important in the maintenance of healthy bones. (see Table 4)

CONCLUSION

Studies have shown that yacon can lower glucose levels at a certain degree, mimic mRNA expression of insulin, exhibit strong anti-oxidative activity and potent activity against certain bacteria. However, since most of the studies are of level 5 evidence, the usefulness of yacon in diabetes or as an anti-oxidant or anti-bacterial gets only a D for its grade of recommendation.

Yacon is not recommended for therapeutic or supplemental use due to the lack of evidence. However, we recommended that further studies involving human subjects be done because of the potential uses of yacon as seen in animal and in vitro studies.

REFERENCES

Park JS, Yang JS, Hwang BY, Yoo BK, Han K. Hypoglycemic Effect of Yacon Tuber Extract and Its Constituent, Chlorogenic Acid, in Streptozotocin-Induced Diabetic Rats. Biomol Ther. 2009;17(3):256-62.

Taylor L. Yacon (Smallanthus sonchifolius). 2006 [cited 18 Nov 2009]. In Raintree [tropical plant database on the Internet]. Carson City (NV): Raintree Nutrition Inc. Available from: http://www.rain-tree.com/yacon.htm

APPENDIX

A. CLINICAL ABSTRACTS ON YACON AND ITS USE IN DIABETES

Clin Nutr. 2009 Apr;28(2):182-7. Epub 2009 Feb 28.

Yacon syrup: beneficial effects on obesity and insulin resistance in humans.

Genta S, Cabrera W, Habib N, Pons J, Carillo IM, Grau A, Sánchez S.

BACKGROUND & AIMS: Syrup obtained from yacon roots could be well positioned as a nutraceutical product due to its high fructooligosaccharides content. We examined the beneficial effects and tolerance of yacon syrup on human health. METHODS: Obese and slightly dyslipidemic pre-menopausal women were studied over a 120-day period in a double-blind placebo-controlled experiment. We used two doses of yacon syrup, 0.29 g and 0.14 g fructooligosaccharides/kg/day. At the start and end of the study, anthropometric measurements, blood glucose, calcium, lipid and insulin concentrations and Homeostasis Model Assessment index were determined. RESULTS: The recommended daily consumption of yacon syrup with no undesirable gastrointestinal effects is 0.14 g fructooligosaccharides/kg. Daily intake of yacon syrup produced a significant decrease in body weight, waist circumference and body mass index. Additionally, decrease in fasting serum insulin and Homeostasis Model Assessment index was observed. The consumption of yacon syrup increased defecation frequency and satiety sensation. Fasting glucose and serum lipids were not affected by syrup treatment and the only positive effect was found in serum LDL-cholesterol levels. CONCLUSIONS: Yacon syrup is a good source of fructooligosaccharides and its long-term consumption produced beneficial health effects on obese pre-menopausal women with insulin resistance.

J Agric Food Chem. 2007 Sep 19;55(19):7726-31. Epub 2007 Aug 23.

Induction of glucokinase mRNA by dietary phenolic compounds in rat liver cells in vitro.

Valentová K, Truong NT, Moncion A, de Waziers I, Ulrichová J.

Diabetes and its complications, including oxidative stress, are major reasons for medical intervention and one of the most frequent causes of death in developed countries. Several lines of data suggest that the use of certain dietary polyphenolic compounds may alter glucose metabolism, thus decreasing the risk for type 2 diabetes. In this paper, we present the effect of phenolic acids (caffeic, chlorogenic, rosmarinic, and ferulic) and extracts from Smallanthus sonchifolius and Prunella vulgaris on glucose production in rat hepatocytes and on glucokinase, glucose-6-phosphatase, and phosphoenol-pyruvate carboxykinase mRNA expression in rat hepatoma Fao cells. The phenolics at 500 microM and after 1 h incubation lowered glucose production via both gluconeogenesis (10 mM alanine or dihydroxyacetone as precursors) and glycogenolysis compared with metformin. Most of the phenolics increased the level of glucokinase mRNA after 24 h in the same way as insulin (10(-7) M).

J Agric Food Chem. 2007 Mar 21;55(6):2424-30. Epub 2007 Feb 23.

Polyphenol oxidase from yacon roots (Smallanthus sonchifolius).

Neves VA, da Silva MA.

Polyphenol oxidase (E.C. 1.14.18.1) (PPO) extracted from yacon roots (Smallanthus sonchifolius) was partially purified by ammonium sulfate fractionation and separation on Sephadex G-100. The enzyme had a molecular weight of 45 490+/-3500 Da and Km values of 0.23, 1.14, 1.34, and 5.0 mM for the substrates caffeic acid, chlorogenic acid, 4-methylcatechol, and catechol, respectively. When assayed with resorcinol, DL-DOPA, pyrogallol, protocatechuic, p-coumaric, ferulic, and cinnamic acids, catechin, and quercetin, the PPO showed no activity. The optimum pH varied from 5.0 to 6.6, depending on substrate. PPO activity was inhibited by various phenolic and nonphenolic compounds. p-Coumaric and cinnamic acids showed competitive inhibition, with Ki values of 0.017 and 0.011 mM, respectively, using chlorogenic acid as substrate. Heat inactivation from 60 to 90 degrees C showed the enzyme to be relatively stable at 60-70 degrees C, with progressive inactivation when incubated at 80 and 90 degrees C. The Ea (apparent activation energy) for inactivation was 93.69 kJ mol-1. Sucrose, maltose, glucose, fructose, and trehalose at high concentrations appeared to protect yacon PPO against thermal inactivation at 75 and 80 degrees C.

Yakugaku Zasshi. 2006 Aug;126(8):665-9.

[Constituents relating to anti-oxidative and alpha-glucosidase inhibitory activities in Yacon aerial part extract]

[Article in Japanese]

Terada S, Ito K, Yoshimura A, Noguchi N, Ishida T.

Hot water extract of the aerial part of Yacon (Smallanthus sonchifolia, Compositae) showed potent free radical-scavenging activity and inhibitory effects on lipid peroxidation in rat brain homogenate. The most potent antioxidative activity focused on the 50% MeOH-eluted fraction on DIAION HP-20 column chromatography. The structure of the major component in the fraction was identified as 2,3,5-tricaffeoylaltraric acid (TCAA) based on spectroscopic evidence. The antioxidative activity of TCAA is superior to that of natural antioxidants such as (+/-)-catechin, alpha-tocopherol, and ellagic acid, and TCAA also showed selective maltase-inhibitory activity (IC(50) 49 microg/ml). As the hypoglycemic activity of Yacon extract was described in a previous report, the present results showing that the aerial part of Yacon has strong antioxidative activity may encourage its potential use as a food supplement to prevent type II diabetes.

Food Chem Toxicol. 2005 Nov;43(11):1657-65.

Subchronic 4-month oral toxicity study of dried Smallanthus sonchifolius (yacon) roots as a diet supplement in rats.

Genta SB, Cabrera WM, Grau A, Sánchez SS.

Yacon roots are a rich source of fructooligosaccharides (FOS) and have a long use tradition as food in the Andean region. However, there are no published reports regarding their toxicology and use safety. The aim of this study was to analyze the effects of subchronic (4-months) oral consumption of dried yacon root flour as a diet supplement using normal Wistar rats. Two daily intake levels were used, equivalent to 340 mg and 6800 mgFOS/body weight, respectively. Yacon administered as a diet supplement was well tolerated and did not produce any negative response, toxicity or adverse nutritional effect at both intake levels used. Yacon root consumption showed no hypoglycemic activity in normal rats and resulted in significantly reduced post-prandial serum triacylglycerol levels in both doses assayed. Conversely, serum cholesterol reduction was not statistically significant. Cecal hypertrophy was observed in rats fed only the high dose. Our results indicating lack of toxicity and a certain beneficial metabolic activity in normal rats warrant further experiments with normal subjects and patients suffering metabolic disorders. They should also be considered when establishing the regulatory framework of this natural product by national health authorities and international trade agencies.

Cell Biol Toxicol. 2004 Mar;20(2):109-20.

The effect of Smallanthus sonchifolius leaf extracts on rat hepatic metabolism.

Valentová K, Moncion A, de Waziers I, Ulrichová J.

Smallanthus sonchifolius (yacon), originating from South America, has become popular in Japan and in New Zealand for its tubers which contain beta-1,2-oligofructans as the main saccharides. The plant is also successfully cultivated in Central Europe in the Czech Republic in particular. Its aerial part is used in Japan and in Brazil as a component in medicinal teas; while aqueous leaf extracts have been studied for their hypoglycemic activity in normal and diabetic rats. We have already demonstrated the high content of phenolic compounds in yacon leaf extracts and their in vitro antioxidant activity. In this paper, we present the effects of two organic fractions and two aqueous extracts from the leaves of S. sonchifolius on rat hepatocyte viability, on oxidative damage induced by tert-butyl hydroperoxide (t-BH) and allyl alcohol (AA), and on glucose metabolism and their insulin-like effect on the expression of cytochrome P450 (CYP) mRNA. All the extracts tested exhibited strong protective effect against oxidative damage to rat hepatocyte primary cultures in concentrations ranging from 1 to 1000 microg/ml, reduced hepatic glucose production via gluconeogenesis and glycogenolysis at 1000 microg/ml. Moreover, the effects of the organic fractions (200 and 250 microg/ml) and to a lesser extent, the tea infusion (500 microg/ml) on rat CYP2B and CYP2E mRNA expression, were comparable to those observed with insulin. The combination of radical scavenging, cytoprotective and anti-hyperglycemic activity predetermine S. sonchifolius leaves for use in prevention and treatment of chronic diseases involving oxidative stress, particularly diabetes.

Yakugaku Zasshi. 2004 Apr;124(4):217-23.

[Suppression of glucose absorption by various health teas in rats]

[Article in Japanese]

Matsuura T, Yoshikawa Y, Masui H, Sano M.

The inhibitory effects on the intestinal digestion and absorption of sugar of health teas that claim beneficial dietary and diabetes-controlling effects were compared in rats using portal cannulae. The measured durations were the times during which the elevation of portal glucose levels resulting from continuous intragastric infusion of sucrose or maltose was suppressed by concentrated teas. The teas investigated included salacia oblonga, mulberry, guava, gymunema, taheebo, yacon, and banaba. The duration of the inhibitory effect on the sucrose load of salacia oblonga, mulberry, and guava were 110 min, 20 min, and 10 min, respectively. In contrast, gymunema, taheebo, yacon, and banaba had no significant effect on the continuous infusion of sucrose. These results suggest that there is considerable difference in the efficacy of commercial health teas in influencing glucose absorption.

J Ethnopharmacol. 2001 Feb;74(2):125-32.

Hypoglycemic effect of the water extract of Smallantus sonchifolius (yacon) leaves in normal and diabetic rats.

Aybar MJ, Sánchez Riera AN, Grau A, Sánchez SS.

The hypoglycemic effect of the water extract of the leaves of Smallantus sonchifolius (yacon) was examined in normal, transiently hyperglycemic and streptozotocin (STZ)-induced diabetic rats. Ten-percent yacon decoction produced a significant decrease in plasma glucose levels in normal rats when administered by intraperitoneal injection or gastric tube. In a glucose tolerance test, a single administration of 10% yacon decoction lowered the plasma glucose levels in normal rats. In contrast, a single oral or intraperitoneal administration of yacon decoction produced no effect on the plasma glucose levels of STZ-induced diabetic rats. However, the administration of 2% yacon tea ad libitum instead of water for 30 days produced a significant hypoglycemic effect on STZ-induced diabetic rats. After 30 days of tea administration, diabetic rats showed improved body (plasma glucose, plasma insulin levels, body weight) and renal parameters (kidney weight, kidney to body weight ratio, creatinine clearance, urinary albumin excretion) in comparison with the diabetic controls. Our results suggest that yacon water extract produces an increase in plasma insulin concentration.

Philippine Council for Health Research and Development

The phytochemical screening, instrumental analysis and determination of the hypoglycemic property of resings from the yacon tubers (Smallanthus sonchifolius)

Capati KM, Fernandez JEA, Godoy SI, Meneses MR.

This study deals with the determination of the hypoglycemic property of the resin extract obtained from the yacon tubers, scientifically known as Smallanthus sonchifolius from the family Asteraceae.

The extracts of yacon tubers were studied for potential hypoglycemic property to glucose induced rabbits. Dose levels of 0.25mg/kg, 0.5mg/kg, 1g/kg and 1.5g/kg were administered orally to the rabbits after the oral administration of CMC solution. After the time interval of 5,10 and 24 hours, blood samples were collected through the ear veins of the rabbit using surgical needle. The fresh blood sample collected was then placed in the test spot Ames Glucose Strip and Inserted into the glucometer. The pharmacological testing done on hypoglycemic rabbits showed that three doses of the plant extract of the Yacon tubers possess glucose lowering activity in the 5 and 10 hours interval but on the 24 hours the blood glucose level increased again. The result obtained using Euglocon as a positive control helped evaluate the laboratory procedure used in testing for hypoglycemic property of the yacon tubers even though the plant extract is not as effective as Euelocon in maintaining hypoglycemia.

B. CLINICAL ABSTRACTS ON YACON AND ITS OTHER POTENTIAL USES

Yakugaku Zasshi. 2006 Aug;126(8):665-9.

[Constituents relating to anti-oxidative and alpha-glucosidase inhibitory activities in Yacon aerial part extract]

[Article in Japanese]

Terada S, Ito K, Yoshimura A, Noguchi N, Ishida T.
[see in Clinical Abstracts on Yacon and Its Use in Diabetes]

Cell Biol Toxicol. 2004 Mar;20(2):109-20.

The effect of Smallanthus sonchifolius leaf extracts on rat hepatic metabolism.

Valentová K, Moncion A, de Waziers I, Ulrichová J.
[see in Clinical Abstracts on Yacon and Its Use in Diabetes]

J Agric Food Chem. 2005 Jul 13;53(14):5577-82.

Radical scavenging and anti-lipoperoxidative activities of Smallanthus sonchifolius leaf extracts.

Valentová K, Sersen F, Ulrichová J.

Radical scavenging and anti-lipoperoxidative effects of two organic fractions and two aqueous extracts from the leaves of a neglected Andean crop-yacon (Smallanthus sonchifolius Poepp. & Endl., Asteraceae) were determined using various in vitro models. The extracts' total phenolic content was 10.7-24.6%. They exhibited DPPH (IC50 16.14-33.39 microg/mL) and HO* scavenging activities (4.49-6.51 mg/mL). The extracts did not scavenge phenylglyoxylic ketyl radicals, but they retarded their formation. In the xanthine/xanthine oxidase superoxide radical generating system, the extracts' activities were 26.10-37.67 superoxide dismutase equivalents/mg. As one of the extracts displayed xanthine oxidase inhibitory activity, the effect of the extracts on a nonenzymatically generated superoxide was determined (IC50 7.36-21.01 microg/mL). The extracts inhibited t-butyl hydroperoxide-induced lipoperoxidation of microsomal and mitochondrial membranes (IC50 22.15-465.3 microg/mL). These results make yacon leaves a good candidate for use as a food supplement in the prevention of chronic diseases involving oxidative stress.

Biosci Biotechnol Biochem. 2003 Oct;67(10):2154-9.

Purification and identification of antimicrobial sesquiterpene lactones from yacon (Smallanthus sonchifolius) leaves.

Lin F, Hasegawa M, Kodama O.

The extraction of yacon [Smallanthus sonchifolius (Poepp. and Endl.) H. Robinson; Asteraceae] leaves and chromatographic separation yielded two new antibacterial melampolide-type sesquiterpene lactones, 8beta-tigloyloxymelampolid-14-oic acid methyl ester and 8beta-methacryloyloxymelampolid-14-oic acid methyl ester, as well as the four known melampolides, sonchifolin, uvedalin, enhydrin and fluctuanin. The newly identified compound, 8beta-methacryloyloxymelampolid-14-oic acid methyl ester, exhibited potent antimicrobial activity against Bacillus subtilis and Pyricularia oryzae, while 8beta-tigloyloxymelampolid-14-oic acid methyl ester showed lower activity. Fluctuanin exhibited the strongest antibacterial activity against B. subtilis among these six sesquiterpene lactones.

Digestion. 2008;78(1):30-3. Epub 2008 Sep 10.

Effect of yacon (Smallanthus sonchifolius) on colonic transit time in healthy volunteers.

Geyer M, Manrique I, Degen L, Beglinger C.

BACKGROUND: Yacon is a root crop which contains high amounts of fructooligosaccharides (FOS). The aim of this study was to investigate the effects of yacon syrup on colon transit time in healthy volunteers. METHODS: In a placebo-controlled, double-blind study yacon was administered to 16 healthy individuals (8 males, 8 females) in a dose of 20 g daily (equal to 6.4 g FOS) in a 2-week crossover design. Each period was interrupted by a 2-week wash-out phase. Transit time was assessed by a radio-opaque marker technique. RESULTS: Transit time (mean +/- SEM) through the gastrointestinal tract was significantly decreased from 59.7 +/- 4.3 to 38.4 +/- 4.2 h ($p < 0.001$). Yacon was well tolerated with an excellent side effect profile. Bloating is not an uncommon side effect observed with FOS, but bloating-related disturbances were not

significantly more often reported with yacon compared to placebo. Stool frequency increased from 1.1 +/- 0.1 to 1.3 +/- 0.2 times per day and the consistency showed a tendency for softer stools as assessed by a numerical depicted stool protocol. Neither parameter did, however, reach statistical significance. CONCLUSION: Yacon markedly accelerates colonic transit in healthy individuals. Further studies are needed in constipated patients to confirm these preliminary data. Due to the low caloric content of yacon, the root could be a useful treatment in constipated diabetics or obese patients.

Br J Nutr. 2007 Apr;97(4):776-85.

Effects of fructans-containing yacon (Smallanthus sonchifolius Poepp and Endl.) flour on caecum mucosal morphometry, calcium and magnesium balance, and bone calcium retention in growing rats.

Lobo AR, Colli C, Alvares EP, Filisetti TM.

Yacon roots have been considered a functional food due to the high levels of fructans they contains. In the present study, Ca and Mg balance, bone mass and strength, and caecum mucosal morphometry were evaluated. Growing male Wistar rats (n 24) were fed ad libitum control diets or diets supplemented with yacon flour (5 or 7.5 % fructooligosaccharides) for 27 d. Mineral balance was evaluated in three periods of 5 d (starting on the 4th, 10th and 16th days). After the rats were killled, the bones were removed and bone mineral density was measured. Ca analyses were performed on left femurs and tibias and biomechanical testing on right femurs. The caecum was removed and tissue samples were collected for histological analysis. Caecal histology changed noticeably in rats fed yacon flour: there was an increase in the depth and number of total and bifurcated crypts as well. Yacon flour consumption significantly ($P < 0.05$) resulted in a positive Ca and Mg balance, leading to higher values of bone mineral retention and biomechanical properties (peak load and stiffness) when compared to the control group. The positive effects on mineral intestinal absorption, bone mass and biomechanical properties showed an important role of yacon roots in the maintenance of healthy bones. The increased number of bifurcating crypts might be related to the higher mineral absorption caused by the enlargement of the absorbing surface in the large intestine of the animals.