VARIABILITY AND INTER-RELATIONSHIPS BETWEEN YIELD AND ASSOCIATED TRAITS IN TARO (*Colocasia esculenta* (L.) Schott.)

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ABSTRACT

The genetic variability and inter-relationships between yield and associated traits in some taro genotypes were investigated in two years across two locations. The experiment was laid out as randomized complete block design with three replications in each location. Data were collected on the growth and yield attributes of taro. The genetic variability of the attributes measured in both locations was studied to estimate the genotypic (GCV) and phenotypic (PCV) coefficients of variation, broad sense heritability (*h*²*₅*) and genetic advance (GA). Considering GCV, *h*²*₅*, and GA simultaneously as the best estimators of the amount of advance expected from selection, number of secondary shoots/plant and number of leaves/plant gave the highest values in each of the locations. This shows that a satisfactory selection program for improvement of these genotypes through these traits is possible at each specific location. Correlation analysis showed that all the traits measured were significantly and positively correlated with taro yield except corm and cormel lengths. Number of cormels/plant had the strongest positive correlation with taro yield (*r* = 0.699**) followed by cormel weight (*r* = 0.624**). Path-coefficient analysis and stepwise multiple regression analysis revealed cormel weight and number of cormels/plant as the biggest determinants of taro yield, both contributing about 72% of the total variation in yield. This suggests that these two characters are important selection indices for taro yield improvement.

**Keywords:** Genotypes, path analysis, hertiaility, genetic advance.
International network for edible aroids (INEA) to access high value ‘taro [Colocasia esculenta (L.) Schott]’ for adaptive food and nutrition


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Taro [Colocasia esculenta (L.) Schott] of family Araceae is the 5th most important root crop consumed worldwide. Domestication of taro is as old as 4000-7000 years. This shade loving, highly productive (15-20 t/h), profitable crop is associated with ethnic culture and revenue generation in fragile ecosystem across Asia, Oceania, Africa and South America. Despite its wide domestication the crop is vulnerable to disease and pests owing to narrow genetic base. Gene flow in taro is impeded due to sexual degeneration, lack of flowering, protogyny, ploidy variability etc. To overcome these challenges and to make taro more adaptive to climate changes and to satisfy consumer demands, an International Network for Edible Aroids (INEA) is already on the wheel since April 2011 involving 22 different countries. The system is based on National Agricultural Research System (NARS) among the different nations, thereby widening the ample scope to share taro diversity for its genetic enhancement. The programme with the ground reality of involving taro growers at grass roots through “Farmers, Researchers participatory evaluation and breeding” in each nation is an unique user friendly ‘Global programme’. In India, the genetic materials introduced in in vitro forms were multiplied, hardened and distributed to targeted sites for evaluation. The DNA analysis under INEA has revealed wide diversity in North Eastern parts of India. Mineral contents analysis revealed taros are rich in macro and micronutrients especially triploid taros are highly enriched with micro nutrients like Fe, Zn, Ca etc. To widen the genetic base, exotic and indigenous lines with high yield, good culinary quality, palatability, resistant to taro leaf blight and enriched with microelements were selected and hybridized. Seeds raised from different combinations were germinated in vitro. Growth and evaluation of seedling progenies are going on for its vertical and horizontal dissemination towards adaptive food-nutrition and livelihood.
On-Farm Participatory Evaluation and Selection of Taro towards increasing Taro Genetic Diversity in Papua New Guinea

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Farmer’s participation in selection of new variety is an economical approach to quickly increase diversity and the rate of adoption of crops. A total of 48 taro lines were evaluated in five communities across four provinces in Papua New Guinea (PNG). The genotypes comprised of those from Hawaii, Samoa, Japan, Vanuatu, Malaysia, Thailand, Japan and Indonesia. These were initially evaluated together with local landraces and elite breeding lines at the National Agricultural Research Institute experimental fields before going through series of on farm participatory evaluation and selection. Taste, yield (t/ha) and corm shape and size have been the bases for selection. In total 16 lines were collectively selected by communities based on their local preferences and have adopted the new genotypes/varieties to broaden their genetic base. Samoa and PNG lines have been the favourites. The participatory evaluation-selection approach has served useful in extending research technologies to PNG villages.
Climate change and sustainable management of taro (*Colocasia esculenta*) leaf blight in Cameroon

**Abstract**
Climate change is a change in the statistical distribution of weather over periods of time that range from decades to millions of years. An epidemic devastated taro (*Colocasia esculenta*) in West and Central Africa between 2005-2010 causing an estimated loss of over 70 billion FCFA to the Cameroonian economy followed by food insecurity, persistent price hikes and changes in feeding habits. The Ministry of Agriculture and Rural Development and the Ministry of Scientific Research and Innovation conducted surveys and wrote reports but no mitigation strategy was proposed. In this light, trials were conducted with a prepacked fungicide (copper (II) oxide and metalaxyl) at 7-, 14-, 21- and 28-day spray frequencies. In another trial, taro was sown in December (03 months earlier) followed by constant irrigation. Results showed that a 28-day spray regime could be selected based on high yields of 60.44 t/ha, yield increase of 74.06, net benefit of 8.27 million FCFA/ha and a rate of return of 13.78. Results of irrigation gave yields of 61.81 t/ha and yield increase of 75.85 % were with corresponding net benefits of 12 million FCFA/ha and a rate of return of 11.29. Consequently, early planting and monthly fungicide application can by proposed to farmers as these management methods are environmentally-friendly. In future perspectives, further research in other agroecological zones and more active ingredients - are recommended.

**Keywords**: taro leaf blight, *Phytophthora colocasiae*, spray frequency, irrigation, sustainability, environment
Optimisation of Brownies Formulation Made of Taro Composite Flour

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Introduction
Brownie is a kind of popular cake often consumed for social activities including snacking and celebrations, and is usually made of wheat flour. An Asian recipe for preparation of brownies comprises flour, sugar, powder of cocoa, baking powder, eggs and glycerol mono-stearate (GMS). After dough preparation, cookies are often oven-cooked at 150-170 °C for 30 min (Bennion and Bamford 1979; Sunaryo 1985). The present study aims at investigating the textural properties of different formulations of brownies without wheat and using some composite flour made of taro, banana, and mung bean, and tries to recommend a corresponding optimal formulation.

Key words: Brownies, Formulation, Taro Composite Flour, RSM

Method
A response surface method with a composite design was used. Various amounts of GMS in the 0.14-0.26% range, baking powder in the 0.2-0.52% range, and skim milk in the 6.4-7.6% range were used in addition to the composite flour made of 50% taro, 30% of banana and 20% of mung bean without wheat ingredient. Final products were then analyzed using an uniaxial texturometer that recorded force-time curve equivalent to an instrumental texture profile analysis (TPA), with hardness 1 (max. force in g at first puncture), hardness 2 (max. force in g at second puncture), resilience (dividing the upstroke energy of the first compression by the down stroke energy of the first compression), cohesiveness (area of work during the second compression divided by the area of work during the first compression), springiness (percentage of a product's original height), and chewiness (Hardness 1 by Cohesiveness by Springiness) as per Texture Technologies (2015).

Results
The minimum hardness data on both puncture cycles recorded in the 155-843g and 122-718g range, respectively; which in turn helped to describe the brownie tenderness. Tenderness was optimal for an intermediate amount of baking powder, and a relatively high amount of skim milk. Complementary resilience, springiness, and cohesiveness were also recorded in the 0.38-0.53 range, 2.1–2.6 range, and 0.66-0.83 range, respectively. If no optimum was observed for resilience, springiness and cohesiveness parameters fitted with a polynomial model, the
chewiness parameter was revealed being strongly influenced by the addition of baking powder and glycerol mono-stearate and skim milk, and is likely to significantly contribute to the organoleptic perception of the product.

**Conclusion**
The present investigation confirmed the interest of some earlier trials, where using composite flour made of taro, banana and mung bean without wheat, could be used for the formulation of brownies. The polynomial model of prediction gave an optimum of formulation using 0.24% of glycerol mono-stearate, 0.36% of baking powder, and 7.32% of skim milk. Some later investigations will be needed to test the corresponding consumer acceptability using some ranking tests for the formulated brownies.

**References**

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Taro starch is one of the most nutritious, easily digested foods. Like many other root crops taro corms are high in carbohydrate in the form of starch and low in fat and protein. It has been reported that understanding the physicochemical and functional properties of flours from raw and processed root and tuber crops may help us in fortification of taro flour with other flours and the development of value added products from taro. Therefore, in this study two improved cultivars of taro (Boloso I and Acc.236000) which were grown in Wollaita zone of Southern Ethiopia were analyzed for their functional properties, physicochemical properties and antinutritional factors composition. The effects of processing (boiling and fermentation) on these parameters were also determined. Among the functional properties studied; water and oil absorption capacity ranged from 1.85-3.82 and 0.9-1.63 ml/g, bulk density; 0.69-0.88 g/ml, emulsion capacity 10.6-35.6ml/g, emulsion stability 7.4-12.9 ml/g and foaming capacity 7.4-12.9 ml/g. Values for some physicochemical properties include; pH 4.92-6.44, TTA 0.32-1.71%. Therefore the study suggested that taro flour can be incorporated in food formulations for development of value added products.

Key Words: Boloso I, Ethiopia, functional properties, Taro
Use of nuclear and chloroplastic markers to unlock the genetic diversity, diversification and dispersal of taro (Colocasia esculenta L.).


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Taro (Colocasia esculenta (L.) Schott) is widely distributed in tropical and sub-tropical areas. However, its origin, diversification and dispersal remain unclear. Using sample covering nineteen countries from the four continents (Asia, Pacific, Africa and America), NGS sequencing of chloroplast and nuclear microsatellite markers, we investigated its genetic diversity and dispersal. The highest genetic diversity and number of private alleles were observed in Asia, mainly in India in comparison with the other continents. While taro is mostly diversified in Asia and Pacific by the means of sexual reproduction, in the countries from Africa and America it is mostly diversified by clonal propagation. Bayesian clustering led to a first genetic group representative of diploids from Asia-Pacific and to a second one gathering diploids and triploids mainly from India. Admixed varieties between the two genetic pools were also found. The phylogenetic tree and the haplotype network revealed three distinct haplotype groups that have highly diverged. The geographical distribution of haplotypes allows the identification of the most likely ancestor origin area of each variety analyzed and shows that the diffusion of taro from Asia to other countries follows a specific pattern. Thus dispersal of taro in the different areas of Africa and America will be discussed in the light on records of voyages and settlements available.
Production of taro (*Colocasia esculenta*) planting material enhanced by bioreactor system.

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Taro (*Colocasia esculenta*), is a staple food crop in most Pacific Island countries. It is an important export crop for some countries and also has cultural and traditional significance. In 1993, an outbreak of taro leaf blight in Samoa and American Samoa had catastrophic effects for food and income security. Traditional taro varieties were highly susceptible, in particular the most popular Samoan variety, ‘Niue’. Production and consumption were drastically reduced and exports fell from 6,000 tonnes in 1993 to almost zero in 1994. The introduction of exotic varieties contributed to the revival of exports though they remained low at 1,000 tonnes until 2010. In 2013 and 2014, exports increased based on new dynamic Samoan taro breeding lines (Samoa 1 and 2). Recent trial exports of frozen taro to Australia by the Scientific Research Organisation of Samoa have also shown promising results. The export varieties (crosses of Pacific and Asian cultivars) were produced by regional breeding programs based in Samoa supported by donors and led by the Secretariat of the Pacific Community (SPC) with partners. However, to meet current and future export demand, new mass production methods are needed. Previously, the use of a bioreactor system in breadfruit micropropagation was shown to shorten the time required for field readiness of plantlets to 30 weeks from 44 weeks at SPC’s Centre for Pacific Crops and Trees (CePaCT) in Fiji. Similarly, the use of the bioreactor system for taro reduced the time required for field readiness of plantlets by 8 weeks (from 28 weeks to 20 weeks). A three-stage system, which combined use of a static conventional system in stages 1 and 2 and a bioreactor system in stage 3, was shown to give the best results. This system produced shoot proliferation of eight shoots per explant when plants were exposed to Murashige and Skoog medium (MS) containing 10 mg/L of 6-benzylaminopurine (BAP) for two weeks (stage 1), followed by exposure to hormone-free solid MS medium for two weeks (stage 2), and final transfer to hormone-free liquid MS medium using the bioreactor system for eight weeks (stage 3). Bioreactor-treated plantlets showed 100% survival, compared to 94% for glass-treated plantlets, and were ready for field planting within 8 weeks of acclimatisation in the screen house. Glass-treated plantlets required another 12 weeks of acclimatisation before field planting. The bioreactor-treated plantlets were sturdier, more vigorous and taller than those cultured using a conventional semi-solid static system. This research is part of the SPC project “Developing a clean seed system for market-ready taro cultivars in Samoa” funded by the Australian Centre for International Agricultural Research under the Pacific Agribusiness Research Development Initiative.
Acceleration of ROS Scavengers in taro (Colocasia esculenta L. Schott) through mutagenesis against Phytophthora leaf blight disease

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Abstract

Taro (Colocasia esculenta L. Schott) ranks fourteenth among the vegetable crops grown worldwide. It is believed to be originated in the north eastern hill (NEH) region of India, Indo-Burma region in particular and considered to be one of the most important traditional food crops among the tribal community of this region. Taro leaf blight (TLB) caused by Phytophthora colocasiae Raciborsky is reported to be the most serious disease in taro which causes yield reduction to the tune of 50%. Acceleration of host resistance is given priority in the disease control strategy where chemical control is not practicable due to waxy leaf surface in taro. A study has been conducted at ICAR Research complex for Northeast Hill Region, Manipur Centre, India to understand the role of ROS scavengers in induction of resistance in taro genotypes through gamma ray induced mutagenesis against TLB. The activity of the superoxide dismutase (SOD), polyphenol oxidase (PPO), catalase (CAT), mono dehydro ascorbate reductase (MDAR) and different forms of peroxidases (ascorbate and guaiacol peroxidases) were increased significantly under mutant progenies (1.0 kR of gamma rays from 60Co source) in M2 generation while compared with non-irradiated control. A significant increase in HR response was observed in induced mutant progenies as compared to the control. Polymorphism among the mutant progenies was investigated with DNA based markers (SSR and RAPD) in the tested lines and were categorised into different clusters. The study on induction of first line of defense mechanism would be helpful to develop resistant lines in taro against leaf blight disease at a shorter pace. We have also focused to observe the transcriptional profiling of irradiated and non-irradiated progenies of taro after challenging with the Phytophthora spores which would also give an insight into the molecular events associated with induced immune response in taro.

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Development Of New Genotypes Of Taro (Colocasia esculenta) In Nigeria

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Declining yields of local taro cultivars, worsened in recent years by outbreak of taro leaf blight (TLB), necessitate the development of varieties that combine TLB resistance with high yield and quality. The objectives of the experiment were to evaluate newly introduced genotypes of Taro for TLB resistance, high yield and quality; and develop new TLB resistant genotypes by crossing between promising exotic and local cultivars. Fifteen exotic cultivars of taro obtained from International Network on Edible Aroids (INEA) as part of an EU-funded project on "Adapting Clonally Propagated Crops to Climatic and Commercial Change," and four local cultivars were evaluated and used to constituted the crossing block at Umudike (5°24’ to 5°30’ N; 7°31’ to 7°37’E) in south eastern Nigeria in 2013 and 2014. Results obtained indicate that BL/PNG/13 was highly resistant while BL/SM/152 was immune to TLB while many other exotic cultivars and all locals were susceptible. Both exotic cultivars were late maturing. There was a positive correlation between maturity and resistance to TLB suggesting a possible linkage between genes responsible for these attributes. Cultivar differences in number of corms, cormels and total yield (corms + cormels) per plant were significant in both years. Total yield and Corm/Cormels ratio of many exotic cultivars compared favourably with the locals. Nine cultivars were selected as promising based mainly on yield, physical appearance, resistance to TLB and lack of stolon. 23% of crosses made amongst selected cultivars, and between TLB resistant exotic cultivars and locals were successful. 247 Seedlings raised from seeds resulting from these crosses exhibited marked differences in foliage, tuber yield characteristics, and disease response expected of genetically different individuals. These genotypes will be cloned for further evaluation. Each of these new genotypes could be a potentially improved cultivar. It is also worthy to note that the successful hybridization and growing of taro seedlings from true seeds achieved in this project is the first of its kind in West Africa.

Keywords: Crosses, true taro seed, seedlings, inflorescence, taro cultivars
In the framework of the International network of edible aroids (INEA) project, virus discovery studies of Taro and other edible aroids were conducted to identify viral pathogens and to develop diagnostic reagents and tools for virus indexing. Several Taro viruses are described but because symptom expression in Taro often is not informative, the implication of those viruses in a particular Taro disease remains obscure. We utilized deep sequencing approaches for discovery of viral sequences in Taro materials collected by INEA project partners in the Pacific, a region with intense Taro production and use for daily consumption. In most cases Dasheen mosaic virus, the most ubiquitous of all Taro viruses was found. In Taro plants with “bobone” symptoms, the suspected “Colocasia bobone virus” was reconstructed and identified as a new Cytorhabdovirus. Symptoms of vein clearing indicating Taro vein clearing virus (TaVCV) were found in Vanuatu. The comparison of its RNA genome with a TaVCV sequence previously reported from Fidji revealed a high diversity among these nucleorabdoviruses. Dioscorea bacilliform virus was found in many samples and from sequences and demonstration of virus particles in EM evidence of actual badnavirus infections was provided. A negative-stranded RNA tenuivirus was analysed and evidence for its infectivity was provided by transmission of this virus to N. benthamiana. The virus was found in all regions of the South Pacific, including the Solomons and Vanuatu. Virus findings and consequences for virus indexing and the international exchange of germplasm will be discussed.
AN ASSESSMENT OF TARO YIELD IN TWO CONTRASTING ENVIRONMENTS USING AMMI AND GGE BILOT MODELS

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ABSTRACT
The tuber yield of eight taro (Colocasia esculenta (L) Schott) genotypes across two locations in two years was assessed using the Additive Main Effect and Multiplicative Interaction (AMMI) and Genotype and Genotype-by-Environment (GGE) biplot models. The results of combined analysis of variance for the tuber yield of the genotypes grown in 4 environments showed that the yield was significantly affected by environments (E), genotypes (G) and genotype by environment interactions (GEI). Differences between genotypes and environments accounted for 24.13% and 56.41% of the total variation respectively while genotype x environment interaction accounted for 9.03% of the total variation. The first interaction PCA from the AMMI analysis accounted for 71.10% of variation due to GEI. The biplot accounted for 97.09% of the treatment sum of squares. Both AMMI and GGE models identified NCe 005, NCe 011 and NCe 010 as most stable, while NCe 010 with the highest yield was rated the best. Igbariam 2013 was selected as favourable test environment for the taro yield multi-environment trial. The result showed that application of AMMI and GGE biplots facilitate visual comparison and identification of superior genotype for each target environment.

Keywords: Taro, Locations, Genotype, Environments, AMMI, GGE.
This study optimises the production of composite flours from cocoyam and bambara groundnut flours with cassava starch as binder (sample CBC), and compared with cocoyam and bambara groundnut flours with xanthan gum as binder (sample CBX). The experimental design was carried out using the optimal mixture design of response surface methodology which generated 16 experimental runs where the composite flour components were the variables while the responses were the proximate composition, functional properties and mineral concentration. The proximate composition of sample CBC were 19.55-18.69% protein content, 68.04-72.89% carbohydrate, 0.539-2.47% ash, 1.17-3.70% crude fibre and 2.69-5.94% moisture; while the result of the functional analyses were 7.15-7.95 g/100g water absorption capacity, 7.25-8.45 g/100g oil absorption capacity and 0.70-0.76 g/ml bulk density. The mineral concentrations of sample CBC were 0.51-1.86 mg/100g Iron, 2.00-4.20 mg/100g Calcium, 0.2-0.35 mg/100g Zinc, 6.67-7.62 mg/100g magnesium and 117.00-149.00 mg/100g potassium. The result of the proximate, functional and mineral analyses of sample CBX showed that it was nutritional satisfactory. The optimum blend from the samples were 70 % cocoyam flour, 18.33% bambara groundnut flour, 11.67% cassava starch for sample CBC and 77.916% cocoyam flour, 21.834% bambara groundnut flour and 0.25% xanthan gum for sample CBX. In addition to samples CBC and CBX, a control consisting 60.00% wheat, 10.00% bambara groundnut and 30% cocoyam flour were analysed for rheological, antinutritional and sensory evaluation. The cassava starch and xanthan gum were good sources of food binders; xanthan gum had a better binding effect than cassava starch. The farinograph result for the selected optimized flour blends showed that the flours would be suitable for biscuits production more than for bread production. Also the antinutritional and microbial content of the flours were within acceptable limits. The biscuit produced had good quality properties and microbiologically safe. The result of sensory evaluation showed that the overall acceptability of all samples was not significantly different (p≤0.05) and they were all above 73% acceptability. The study showed that cocoyam and bambara groundnut flour with either cassava starch or xanthan gum serves as a potential composite flour and can adequately replace wheat flour in biscuits production.

Key words: biscuits, cassava, cocoyam, proximate, functional, rheology
Cocoyam is an important food security crop in Ghana because it stores better than all other root and tuber crops. This study sought to identify and examine the key determinants of cocoyam production to guide future policy and strategy formulation. Using a multi-stage sampling technique, 150 cocoyam producers were drawn from Asante-Akyem South, Asunafo North and Fanteakwa Districts in Ghana. Primary data collected through questionnaire administration was used to fit a Cobb-Douglas production function by employing the Stochastic Frontier Approach (SFA). Profitability was examined by using farm income statement to determine gross and net margins as well as returns on investment. The Krippendorff’s Alpha Reliability test was employed to examine constraints faced in cocoyam production. Results from the study showed that cocoyam was predominantly cultivated as an intercrop (84%) with plantain, cocoa, and cassava. However, about 20% of producers in Fanteakwa and Asunafo North districts planted cocoyam as pure stand (monocropping). The average land area under cocoyam cultivation was 0.55 hectares, corm yield was estimated at 6.5mt/ha and cocoyam leaves yield was about 0.59mt/ha. Cocoyam yield under monocropping system was found to be significantly higher than yield under mixed cropping system. Empirical results showed that labour, land area cultivated, quantity of planting materials (corm setts) planted and amount invested in other farm inputs positively influenced cocoyam production. Furthermore, adoption of monocropping system, extension contact, education, farming experience and household size had significant positive effect on corm production. However, the quantity of cocoyam leaves harvested from the crop, herbicide application and continuous cultivation on the same piece of land had significant negative effect on cormel production. Cocoyam production was found to be financially profitable even though profit levels varied across different regions in Ghana. With a Krippendorff Alpha statistic of 0.54, the study showed a fair level of concordance amongst cocoyam producers with respect to production, marketing and socio-economic constraints facing them. Among other things, the study recommended the adoption of monocropping system to improve cocoyam production in Ghana; which is possible only if producers have improved access to farmlands. In this regard, re-introduction of the regulated rotational strategy for using secondary forest lands for food crop production under the Modified Taungya System (MTS) is recommended to boost cocoyam production in the country.
DETERMINANTS OF COCOYAM TECHNOLOGY ADOPTION AMONG FARMERS IN SOUTH EASTERN NIGERIA

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Abstract
It has been established that there is problem of low production in Nigerian agriculture and there had been sudden drop in the yield of cocoyam over the years. Lack of appropriate technology has been found to be one of the factors affecting the utilization of most agricultural technologies. Broadly, this study assessed the factors influencing utilization and adoption of cocoyam technologies in Eastern Nigeria. The specific objectives were to determine the socioeconomic characteristics of the stake holders, identify the various cocoyam technologies developed and transferred by research institute, ascertain the level of awareness, utilization/adoption of cocoyam technologies, analyze the factors influencing cocoyam technology utilization/adoption. The data for the study were collected from 288 farmers in Eastern Nigeria. An interview schedule with a well structured questionnaire was used for the study. The data were analyzed by means of descriptive statistics such as frequency tables, percentages, means, classical model, ordinary least square regression model analysis. The result showed an $R^2$ value of 0.916 which indicates that 91% of variation in the utilization/adoption of cocoyam technologies were explained by the independent variables considered in the study. The major determinants were Coefficient of age, household size, level of income, access to credit, educational status and farm size were the major determinants of cocoyam technology utilization/adoption among the farmers. The result also showed that use of organic manure had the highest level of awareness and utilization ($\bar{x} 3.29$) among the respondents. only five out of the twenty cocoyam technologies studied had been adopted by farmers, an indication of low adoption of cocoyam technologies in the study area. It was recommended that agricultural credit be made available to farmers in Eastern Nigeria since it was a determinants factor influencing cocoyam technology utilization.

Key words: Cocoyam, Technology, Awareness, utilization, Adoption.
ABSTRACT
Post harvest operations such as harvesting, transporting, sorting, grading, packaging and storage of white cocoyam are still done manually in Nigeria. It is therefore pertinent to study its engineering properties so as to form a data base for the development of necessary machinery. The properties determined include tuber length, width, volume, angle of repose, density, static coefficient of friction on plywood, galvanized steel and glass surfaces, force–deformation behaviour during quasi-static radial compression, stiffness modulus and tuber toughness. The experiments were conducted at an average moisture content of 57.65% (wet basis). White cocoyam was found to have length of 9.66 ± 0.65 cm, width of 4.24 ± 0.55 cm, and thickness of 4.20 ± 0.73 cm. The average mass, volume and density were also 126.28 g, 123.75 cm³ and 1.02 g/cm³ respectively. The mean values of coefficient of static friction were 0.31 on wood, 0.31 on glass, 0.22 on stainless and 0.25 on galvanized steel surface. The average value of angle of repose was 14.05. It was observed that in the axial position, the compressive force was about 1967.16 N and in the lateral position, the force required to rupture the cocoyam tuber was about 976.36 N. Results showed toughness of 7.99 Nm in the axial loading positions and 11.87 Nm lateral positions were observed. This indicates a higher value of toughness in the axial position than in the lateral for cocoyam. Experimental results showed values of Young Modulus as 94.26 N/mm² in the axial position and 5515.38 N/mm² in the lateral position. White cocoyam showed deformation of 14.23 mm and 19.63 mm at axial and lateral positions respectively.

Keywords: Cocoyam; Properties; Physical; Mechanical; Mass; friction; Density; Force.
Physicochemical and functional properties of starch from under-utilized yam
(Dioscorea spp) and cocoyam (Xanthosoma maffa (Scoth)) tubers of
Southeast Nigeria

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Physicochemical and functional properties of starches from some under-utilized yam (D. cayenensis, D. dumetorum, and D. bulbifera) and cocoyam (X. maffa (Scoth)) grown in Southeast Nigeria were determined. Analysis of variance showed that yam starches of D. cayenensis and D. bulbifera were characterized by large mean granule sizes (28 and 37.5mm), high amylose content (37.8 and 35%), and high paste clarity (11.6 and 16%). Starches of D. dumetorum and cocoyam, X. maffa (Scoth), were characterized by smaller granule sizes (about 6 and 5mm), low amylose content (11.2 and 13%), and low paste clarity (6 and 9.8%). The gelatinization enthalpy (DH) of D. cayenensis starch (16.7j/g) was higher than the other tuber starches (about 12j/g). Onset, peak, and end temperatures ranged from 73 to 81.3°C, 77.3 to 85.2°C, and 85.4 to 93°C, respectively, with X. maffa (Scoth) having the highest temperatures. The pasting temperatures ranged from 76 to 81°C. Hot paste, cold paste, and final viscosities were from 116.7 to 748 cP, 145.7 to 913.7 cP, and 156.7 to 966.3cP, respectively. D. bulbifera and D. cayenensis maintained higher viscosities than D. dumetorum and X. maffa (Scoth). Low paste clarity of D. dumetorum and X. maffa (Scoth) was associated with their small granule sizes and low amylose content. The physicochemical and functional properties of the yam and cocoyam tuber starches show that they can be used for specific food applications.

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