MATHEMATICAL, PHYSICAL, AND ENGINEERING SCIENCES DIVISION

SOLID WASTE DISPOSAL SITE SELECTION USING IMAGE PROCESSING AND GEOGRAPHIC INFORMATION SYSTEMS (GIS) TECHNIQUES

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This research aims to demonstrate the potential and efficiency of using Geographic Information Systems, GIS, in selecting optimum sites for the storage of solid waste. The study area selected was Cagayan de Oro City and its vicinity in Misamis Oriental as the required data in this area are readilty available. First, the requirements in selecting landfill sites are identified according to government regulations for sound environmental management. The relevant environmental and cultural data are then collected from analogue maps, satellite images, aerial photographs, and field surveys. As soon as these data are converted to digital form, they are analyzed using GIS functions (e.g., proximity operation, Boolean operation) to produce a final map showing the areas meeting all the criteria or the optimum sites for solid waste disposal.

EVALUATION OF A CORN POLLEN-SPECIFIC PROMOTER USING THE *GUS* A GENE IN TRANSGENIC RICE

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The narrow source of cytosterility limits the use of hybrid breeding in other climatic locations and increases the probability of insect and disease epidemics in the cytoplasmic male sterile lines produced. Genetic engineering can be an alternative method for producing plant hybrids. Genes and promoter sequences specific to anther/pollen-specific can be identified to direct inducible transcription and translation of proteins that would render the plant male sterile.

Zmg 13 is a mature pollen-specific gene that is expressed at the time of microspore mitosis and continues to accumulate as the pollen matures. In attempts to develop a genetic engineering system whereby the sterility and fertility of transgenic rice lines produced can be controlled, the activity of the *Zmg* 13 promoter was considered for evaluation. To determine if the corn pollen-specific promoter would function in rice, a polyethylene glycol-mediated transformation method was used to transform rice protoplasts with the *Zmg* 13 promoter starting from the –260 position placed in front of the β-glucuronidase gene (*gus* A). Cells were co-transformed with the *bar* gene, which confers resistance to phosphinothricin (PPT), the active ingredient in the broad spectrum herbicide Basta. Transgenic plants that were resistant to Basta and expressing *GUS* were regenerated after selection in PPT at a selection efficiency of 86.6% and a co-transformation efficiency of 72%. *GUS* expression in the mature pollen was found to be influenced by the number of integration events and the physiological age of the pollen. Minimal integration events were found to yield *GUS* activity approaching 50% of the mature pollen – the expected results based on the hemizygous condition of the plants. Somatic tissues did not express *GUS*. The results indicated that the corn pollen promoter functions in rice and drives the expression of the *gus* A gene in the expected developmental and tissue/cell-specific manner. This is the first report of a monocot pollen-specific promoter isolated from one species, corn, and expressed in another monocot, rice, in a developmental and cell-specific manner.

STUDIES ON THE PROPERTIES OF PLASTIC AND CRYSTAL SCINTILLATORS

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A piece of scintillating material attached to a photomultiplier tube make up a system of scintillating detectors. When a voltage is applied to the cathode of the phototube, detectable signals can be observed and measured with a large-band-width oscilloscope. Comparative studies are done on the properties of a plastic scintillator detector and an inorganic crystal scintillating detector, which in our case is NaI(TI) crystal. The following properties are observed and measured: rise time, fall time, decay width, counter plateau, and dark current.

Using a CAMAC system for spectroscopy studies, the spectra for Cs-137 and other gamma-emitting sources are obtained and compared for plastic scintillators and the NaI(TI) detector.

INVESTIGATIONS ON THE CAMAC DATAWAY OPERATIONS

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An acronym for Computer Automated Measurement and Control, the CAMAC, is an internationally accepted group of standards that fully define the modular-real time interface concept for configuring high-performance data acquisition and control systems. The essential components of the CAMAC system are a crate and plug-in type modules. The crate is composed of slots or stations into which the modules are inserted. At the rear of the module is a card-type connector which mates with a corresponding connector at the back of the slot. This connector contains contact points which couple the module to a series of parallel wires running along the backplane of the crate linking each of the stations. This series of wires is known as the dataway and is the essential feature of the CAMAC system. In modern terms, the dataway would be known as a backplane bus. All communications within a CAMAC crate are overseen by a special module known as the crate controller which is inserted in the last two slots of the crate.

The dataway is the nervous system of the CAMAC system. Communications between modules, crate controller, and host computer are made via the dataway. The dataway signals may be classified into six categories: control, addressing, timing, data, status, and commands. Using a 12-slot CAMAC crate and a few CAMAC modules, investigations were done to determine the relative timing of these signals. The minimum cycle times for one complete CAMAC operation for these types of signals were determined. These data are of crucial importance in the real-time data acquisition algorithms used in any experiment utilizing the CAMAC.

DEVELOPMENT OF AN ENZYMATIC TOXICITY TEST WITH SELECTED PHYLLOPOD SPECIES *(Crustacea: Anostraca and Cladocera)**

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This paper presents the results of a study aimed at the development of a rapid toxicity screening test for routine detection and quantification of toxic hazards. It is probably the very first attempt to explore the potential of using a typical biochemical criterion – enzymatic inhibition – as test criterion for bioassays with *Daphnia magna, Artemia franciscana, Thamnocephalus platyurus,* and *Streptocephalus proboscideus* carried out in vivo. The response can be visualized under UV as the presence or absence of fluorescence in the test organism using fluorogenic or chromogenic indicators after a 1-hour exposure to different concentrations of the toxicant.

The results of electrophoretic analyses to elucidate the fundamental mechanisms behind the enzymatic inhibition criterion showed various degrees of inhibition or induction attributed to the specific mode of action of the chemicals. Comparisons between the results of conventional toxicity tests and the 1-hour enzymatic inhibition tests (1h EIT) on pure chemicals and compounds showed correlations (r^2) ranging from 0.87 to 0.98 depending on the species. The study also showed the utility of the 1h EIT as a toxicity screening test for complex environment samples such as solid waste leachates, monitoring well waters, effluents, and various

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classes of detergents. The sensitivity and comparability of the results of the 1h EIT to other conventional bioassays and the rapidity with which it generates results indicate its potential as a useful component in a battery of toxicity tests.

INHIBITION OF ACTIVITY OF CELL WALL DEGRADING ENZYMES AND GROWTH OF BACTERIAL WILT PATHOGEN (*Pseudomonas solanacearum* E.F. SMITH) BY FLAVONOIDS

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Bacterial wilt remains to be one of the most destructive bacterial diseases of plants including tomato. Whereas cell wall degrading enzymes, such as polygalacturonase and cellulase, were found to accumulate in virulent cultures of the pathogen, phenolic compounds have been shown to exhibit enzyme inhibitory and antifungal activities and thus serve as defense-mechanisms of plants against infection. This study presents the effect of flavonoids on the activities of the exocellular polygalacturonase and cellulase enzymes and on the growth of *Pseudomonas solanacearum.*

Polygalacturonase was significantly inhibited by the seven flavonoids tested and *p*-coumaric acid, a simple phenolic compound. The most effective inhibitor was quercetin, a flavonol with IC_{50}= 7μM while the least effective was apigenin, a flavone with IC_{50}=175.92 μM. Similarly, cellulase was also significantly inhibited by the seven flavonoids and *p*-coumaric acid. However, the most effective inhibitor was taxifolin with IC_{50}=25.0 μM and the least effective inhibitor was catechin with only 77.18% inhibition at 100 μM. The potencies of the inhibitors against the two enzymes were found to be variable.

The growth of *Pseudomonas solanacearum* was inhibited by the flavonoids. The average CFU/mL was significantly reduced by 1.4 to 2.7x as the concentration of quercetin and taxifolin increased. Colony size was reduced and morphology changed from smooth to rough. Quercetin at 25 μM was found to be a better bacteriostatic agent than taxifolin at 100 μM concentration with an average CFU/mL of 7.63×10^6 and 9.13×10^6, respectively, compared to control which had>2.5 x 107 CFU/mL.

HANDMADE SIMPLE CELLS

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Many students consider that the principles of operating cells and batteries are difficult to learn. This presentation aims to disprove the said preconception or misconception. Generally intended for physics and science teachers, the presentation focuses on: advanced testers, how to make a melody tester, structure of a cell, breaking a cell, making a melody battery checker, making 35-centavo cells, and improving simple cells.

SENSITIVITY ANALYSIS IN ALPHA FACTOR ANALYSIS AND ITS NUMERICAL APPLICATIONS

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There are several sensitivity analysis procedures which have been considered by Tanaka and Odaka (1989) to investigate the phenomena of how a small change of data affects the outcome of factor analysis. Among them are those for principal factor analysis (PFA), maximum likelihood factor analysis (MLFA), and least square factor analysis (LFSA). In this study, we apply a similar method to show the sensitivity on alpha factor analysis. (AFA; Kaiser and Caffrey, 1965) which is based upon the psychometric concept of generalizability. The basic idea of AFA is to determine the common factor FJ in such a way that they have maximum correlation with the corresponding universe common factors. Some examples are explained to illustrate the present procedure and a comparison is made in particular with the case of PFA and MLFA.

POLYPHENOLS IN COOKING BANANA – CHANGES DURING RIPENING AND COOKING AND RELATION TO ASTRINGENCY

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Table banana cultivars of Lakatan, Latundan, and Bungulan had low levels of flavan-type or vanillin-positive polyphenols (0.10 to 1.96 mg catechin equivalents (CE/g) and also low levels of protein-precipitable polyphenols (0.05 to 0.59 mg tannic acid equivalents (TAE/g). Cooking banana cultivars, Saba amd Gubao, had 10-fold and 4- to 10-fold higher level of vanillin – positive and protein-precipitable polyphynols.

The levels of phenolic compounds decreased by 6- to 7-fold in the pulp during ripening of banana cv Pundol which was accompanied by loss of astringency and significant lowering of degree of polymerization from 7.27 to 6.21. Gel permeation chromatography of methanol extracts of unripe and ripe pulp of cv Pundol gave elution curves of similar molecular weight range.

When green mature (unripe) Pundol pulp was cooked, flavan-type phenolics increased from 2.79 to 4.56 CG/g while protein-precipitable polyphenols decreased from 2.14 to 0.65 mg TAE/g. There was loss of astringency and a significant decrease in the degree of polymerization from 7.27 to 3.87 upon cooking of unripe Pundol pulp.

However, cooking the yellow mature ripe pulp of Pundol resulted in a significant increase of total phenols and protein-precipitable polyphenols as well as the degree of polymerization from 6.21 to 9.70 and the appearance of astringency. Gel permeation chromatography revealed the formation of a large molecular weight component in the cooked sample.

PRODUCTION OF BETA-CAROTENE FROM *Rhodotorula glutinis*

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The requirement of *beta*-carotene for nutrition and health has attracted research on the development process for its production. The effects of ammonium sulfate, yeast extract, and sugar concentrations on the *beta*-carotene yield from *R. glutinis* were studied on a batch fermentation process. Multiple linear regression analysis was used to determine *beta*-carotene production as a function of ammonium sulfate, yeast extract, and sugar concentration.

Results show that three components used in a fermentation medium had very high significance on the *beta*-carotene yield. Yeast extract had a linear effect, while parabolic curves were obtained for ammonium sulfate and sugar concentrations. The interaction effect of these components was also highly significant on the *beta*-carotene yield. The contour diagrams using the response surface analysis illustrated the optimum fermentation components on *beta*-carotene yield. The concentration of *beta*-carotene was 9 mg/L at the optimal levels of 3 g/L ammonium sulfate, 9 g/L yeast extract, and 50 g/L sugar.

CHEMISTRY RESEARCH IN THE PHILIPPINES FROM 1905 TO 1982

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A total of five hundred sixty-six research projects done in thirteen institutions in the Philippines from around 1905 to 1982 were examined by studying either the summary or the abstract or the outline or sometimes only the title of the research projects. The trends in research topics , area of specialization of the institutes, the universities, and the researches were analyzed, based on the research output. The frequency with which the topics were taken as subject of research was plotted to determine the "popularity" of research topics. The research topics are functions of the nature of the research institute and the field of specialization of the researchers in the universities. Other factors affecting choice of research topics are also discussed. To the extent that the available data allow, thoroughness or follow-through for selected topics was also studied.

MOVEMENT OF ATRAZINE IN INTACT AND PACKED SOIL COLUMNS

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This study attempts to understand the factors affecting the downward transport of atrazine in soils. The movement of atrazine was studied in intact and packed columns of two soils (Pratt loamy and Smolan silty clay loam). Intact columns were collected in PVC pipes while packed columns were constructed by filling plexiglass tubes with sieved (2 mm) soil materials. Atrazine was applied on the surface at the rate of 40- and 58 mg a.i. L^{-1} for Pratt tand Smolan soils, respectively. The soils were leached with distilled water and leachates were collected every 48 h. Breakthrough curves were constructed by plotting relative concentration against pore volume (PV). In Pratt soil, early breakthrough (0.5 PV) of atrazine occurred in both intact and packed columns indicating unrestricted liquid and solute flow through loose and porous soil matrices. In Smolan soil, early breakthrough of atrazine occurred in intact (0.3 PV) but not in packed (2 PV) columns suggesting that atrazine moved preferential flow through macropores in intact columns and its transport was retarded in packed columns because the sieving and packing procedures eliminated the flow channels and sealed up the macropores. Results of the study have important implications on the management of chemicals for agriculture.

WATER QUALITY OF THE COGON RIVER: CURRENT STATUS

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The water quality of the river was determined during a fifteen-month period from September 1994 to December 1995. Baseline data on water quality parameters, namely D.O., pH, temperature, salinity, density, conductivity, transparency,

chlorides, carbonates (hardness), total dissolved solids, and MPN coliform bacteria were gathered to assess the current status of the river.

Litter analysis using a square plot method was conducted in four stations along the embankment of the river. Findings showed that the river is not very polluted. Based on monthly variation per station of the water quality parameters, it is postulated that the Cogon River has the inherent capacity for self-purification.

Recommendations for conservation and sustainable maintenance of acceptable qualities of the river water are proposed.

AN ANTIMUTAGEN FROM *Cucurbita maxima* DUCHESNE FLOWERS

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The antigenotoxic constituent of squash flowers was isolated by a Micronucleus Test-guided fractionation and purification.

Isolate SQFwB2D from the chloroform extract of squash flowers is the most antigenotoxic isolate. It decreased the mutagenicity of tetracycline by 64.7% at a dosage of 100 mg/kg mouse. Statistical analysis using Kruskall Wallis One-Way Analysis of Variance by Ranks showed that SQFwB2D is different from the control group (tetracycline + corn oil) at α=0.001.

GC-MD of isolate SQFwB2D shows 2 peaks at Rt=19.860 (SQFwB2D-1) and 20.242 min (SQFwB2D-2) with relative peak heights of 16:1, respectively. Spectral analyses show that SQFwB2D-1 is 24α-ethyl-5α-cholesta-7trans,22-dien-3β-ol or spinasterol.

MUTAGENICITY STUDIES ON IPIL-IPIL SEED GUMS

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Bulk extraction of ipil-ipil seed gum was done on whole seeds. The ipil-ipil seeds were ground using a blender. They were then placed in boiling water to disperse the gum. The crude gum was purified by fractional precipitation. Physicochemical and chemical studies showed that the gum exhibited properties similar to that of galactomannan from guar gum.

The results of the Micronucleus Test showed that the ipil-ipil seed gum is not mutagenic at dosages of 3 mg and 50 mg/kg mouse. At a dosage of 3 mg/kg body weight, the gum reduced by 57.2% the number of micronucleated polychromatic erythrocytes (MN-PCE) induced by the mutagen tetracycline. An increase in the dosage of the gum to 50 mg/kg mouse led to an 81.0% reduction in MN-PCE. Thus, ipil-ipil seed gum is antimutagenic.