Pakistan Journal of Scientific and Industrial Research

Vol. 48, No. 1 **Contents** **Jan. - Feb. 2005**

Physical Sciences

Short Communication

Biological Sciences

Short Communications

Technology

Pak. J. Sci. Ind. Res. 2005 **48**(1) 1-7

Mass Transfer Rates and Column Heights in Reactive Extraction Processes

Muhammad Tariq Saeed*, Razia Khanam and Muhammad Yar Shaheen
PCSIR Laboratories Complex, Shahrah-e-Jalaluddin Roomi, Lahore-54600, Pakistan

(received August 24, 2002; revised July 15, 2004; accepted July 28, 2004)

Abstract. A mathematical model, which is based on the simultaneous interfacial chemical reactions and diffusion processes, is developed for the extraction of zinc ions from sulphate solution by di(2-ethylhexyl) phosphoric acid in *n*-heptane diluent. Actual column heights were compared with the predicted ones, using the design algorithm based on chemical kinetics. The experimental values of mass transfer coefficients could be varied and were in the range of industrial interest. Using the physicochemical data, hydrodynamics, mass transfer coefficient parameters and reaction kinetics pertaining to the system, it was possible to predict the interfacial flux and column height from first principles with a reasonable degree of accuracy.

Keywords: interfacial flux, reactive extraction, chemical kinetics, zinc/DEHPA, spray column

Pak. J. Sci. Ind. Res. 2005 **48**(1) 8-13

Humidity Effect on the Disintegrant Property of α-Cellulose and the Implication for Dissolution Rates in Paracetamol Tablets

Michael U. Uhumwangho* and Roland S. Okor
Department of Pharmaceutics and Pharmaceutical Technology, University of Benin, Benin City, Nigeria

(received December 16, 2003; revised September 22, 2004; accepted September 28, 2004)

Abstract. A study has been carried out to determine the effect of humidity on the disintegrant property of α-cellulose in tablet formulations. Paracetamol tablets containing α-cellulose (5% w/w) as disintegrant were employed in the study. The tablets were tested for hardness, disintegration time and dissolution rates before and after their exposure to different relative humidities (RH) of 1%, 78% and 100% at 30 °C (room temperature) for various time intervals upto a maximum of 2 weeks. Humidity effect on the particle structure of α-cellulose was determined by photomicroscopy. Tablets exposed to RH of 1% and 78% disintegrated very fast, within a minute, similar to the fresh samples. In contrast, tablets exposed to RH 100% for ≥ 24 h failed to disintegrate within 60 min even though the tablets became softer. Tablet dissolution rate was also markedly impaired in this set of tablets. Exposure of the α-cellulose powder to RH 100% for 24 h caused the particles to gel, which accounted for the impairment of its disintegrant property.

Keywords: α-cellulose, disintegrant property, gel formation, humidity effect

Pak. J. Sci. Ind. Res. 2005 **48**(1) 14-22

Proximate, Mineral and Phytate Profiles of Some Selected Spices Found in Nigeria

E. I. Adeyeye*[a] and E. D. Fagbohun[b]

[a]Chemistry Department, University of Ado-Ekiti, PMB 5363, Ado-Ekiti, Nigeria

[b]Microbiology Department, University of Ado-Ekiti, PMB 5363, Ado-Ekiti, Nigeria

(recieved December 12, 2002; revised September 20, 2004; accepted September 30, 2004)

Abstract. The proximate, mineral and phytate (phy) compositions, as well as the calculations for fatty acid, metabolisable energy, phy:Zn, Ca:phy and [Ca] [phy]/[Zn] were determined in 13 spices (S_{11} - S_{23}) used as seasoning agents in Nigeria. The mean values of various parameters for proximate composition (g/100 g) were: moisture (3.61±3.56), dry matter (96.39±3.56), crude fat (5.46±10.02), crude fibre (27.0±17.34), crude protein (13.78±9.84), ash (4.57±2.22) and carbohydrates (45.58±22.25). Fatty acids were noted to be 4.37±8.02 (g/100 g) and energy was 1211.23±317.64 (kJ/100 g). Significant differences ($P < 0.05$) existed in moisture, dry matter, fat, fibre, crude protein and fatty acid levels. Minerals (mg/100 g) included: Na (183.08±144.19), K (1621.54±1703.99), Ca (505.38±463.24), Mg (243.08±235.74), Zn (434.92±945.86), Fe (72.54±92.38) and P (740±624.64), while Pb, Cu and Co, were not detected. The relationships between Na and K as well as between Ca and P were mostly within the desirable range with the respective ratios of Na/K (0.59±0.87) and Ca/P (2.20±3.32). Significant differences existed among the levels of Na, K, Ca, Mg, Zn, Fe, Na/K and Ca/P. The [Ca] [phy]/[Zn] had an overall mean value of 1.45±1.74 showing that the bioavailability of zinc in the spices may be low (except in S_{21}, S_{22} and S_{23}) due to the high phytate content of the spices.

Keywords: spices, chemical composition, metabolisable energy, phytate levels

Pak. J. Sci. Ind. Res. 2005 **48**(1) 23-27

Effects of Exposures to Cement Dust and Powder on Workers in Cement Distribution/Retail Outlets in Benin City, Nigeria

Ifeyinwa Flossy Obuekwe [ab]* and Lovette Isioma Okoh [a]

[a]Department of Pharmaceutical Microbiology, Faculty of Pharmacy, University of Benin, Benin City, Nigeria

[b]207-10807-47 Avenue, Edmonton, Alberta T6H 5J1, Canada

(received July 15, 2003; revised October 28, 2004; accepted November 2, 2004)

Abstract. This study investigated the effects of exposures to cement dust and powder on workers in fifteen cement distribution/retail outlets in Benin City, Edo State, South-West Nigeria. Forty workers from these retail outlets were initially surveyed by using detailed and open-ended questionnaires as well as oral interviews. Twenty of them were finally subjected to microbiological tests and medical examinations after series of oral interviews and depending on the physical effects of the cement dusts on their skins. Skin, nose and eye swabs, as well as sputum samples of the subjects were collected and cultured using various growth media. Organisms isolated included *Staphylococcus aureus, Branhamella catarrhalis, Bacillus* spp., *Klebsiella pneumoniae, Streptococcus* and *Proteus* species, and some fungi, including *Penicillium, Aspergillus, Trichophyton, Mucor* and *Epidermophyton* species. Chest radiographs were also done to detect the occurrence of silicosis (occupational asthma). The results of this study have shown that depending on the length and level of exposure to cement dust and powder, effects may range from contact dermatitis, skin rash, immediate or delayed irritation of the eyes, as well as chest infections.

Keywords: health hazard, cement dust, cement exposure, dermatitis, silicosis

Pak. J. Sci. Ind. Res. 2005 **48**(1) 28-36

Determination and Seasonal Variation of Heavy Metals in Algae and Sediments in Sewers from Industrial Areas in Lagos State, Nigeria

O. R. Awofolu
Department of Chemistry, Faculty of Science, Lagos State University, Ojo, Lagos State,
PMB 1087 Apapa, Lagos, Nigeria

(received June 25, 2004; revised September 14, 2004; accepted November 25, 2004)

Abstract. The level of heavy metals (Cd, Pb, Cu and Zn) in algae and sediments in sewers from industrial areas was determined by atomic absorption spectrophotometry (AAS). In order to evaluate the metal load of the sewers, as a result of discharged effluents, algae and sediments were collected from three major industrial areas in Lagos, Nigeria during the two main seasons (rainy and dry). Using total digestion, the mean concentration of Cd, Pb, Cu and Zn in algae at Oshodi/Isolo industrial area for the two seasons respectively ranged from 0.04-0.15 μg/g, 0.32-1.86 μg/g, 0.42-1.52 μg/g and 0.10-1.80 μg/g, while those in sediments ranged from not detectable (ND)-0.10 μg/g, 0.12-1.32 μg/g, 0.21-2.65 μg/g and 0.18-1.74 μg/g, respectively. At Iganmu industrial area, the range in algae was ND-0.21 μg/g, 0.20-1.84 μg/g, 0.17-1.90 μg/g and 0.05-1.87 μg/g, while those in sediments was 0.04-0.50 μg/g, 0.22-1.85 μg/g, 0.15-1.78 μg/g and 0.48-2.86 μg/g in the same metal order. The range in algae at Ikeja industrial area was 0.05-0.18 μg/g, 0.08-0.82 μg/g, 0.51-1.40 μg/g and 0.24-2.80 μg/g, while the sediments recorded a range of 0.04-0.60 μg/g, 0.16-0.90 μg/g, 0.24-2.35 μg/g and 0.23-2.84 μg/g, in the respective metal order. Levels of the metals were higher in most samples during the dry season and there were significant differences in the metal concentrations from industrial and residential areas.

Keywords: heavy metals, sewer, algae, sediment, atomic absorption spectrophotometry (AAS)

Pak. J. Sci. Ind. Res. 2005 **48**(1) 37-38

Short Communication

Screening of Fused Pyrimidines as Antimicrobial Agents: Inhibitory Activities of Some Tetrahydrobenzothieno-Pyrimidines

M. M. H. Bhuiyan* and M. Fakruddin

Department of Chemistry, University of Chittagong, Chittagong-4331, Bangladesh

(received April 7, 2004; revised September 30, 2004; accepted October 10, 2004)

Abstract. Seven synthetic tetrahydrobenzothieno fused pyrimidine derivatives were investigated for their antibacterial and antifungal activities. Their comparative ability to inhibit growth of bacterial species *Bacillus subtilis*, *B. megaterium, Staphyllococcus aureus*, *Salmonella typhi* and *Escherichia coli* in comparison with the commercial antibiotic brand Ampicillin, and of fungal species *Verticillium* sp., *Fusarium solanae, Aspergillus* sp., and *Penicillium* sp., in comparison with the commercial antifungal brand Nystatin is reported.

Keywords: fused pyrimidines, thienopyrimidines, antimicrobial activity

Pak. J. Sci. Ind. Res. 2005 **48**(1) 39-41

Determination of Trace Metals in Silver Cat Fish (*Chryssichthys nigrodigitatus*) Associated with Water and Soil Sediments from Beach-Line Fish Ponds

O. O. Ayejuyo[a*], O. G. Raimi [b] and O. R. Moisili [a]

[a]Chemistry Department, Lagos State University, PMB 1087, Apapa Lagos, Nigeria

[b]Biochemistry Department, Lagos State University, PMB 1087, Apapa Lagos, Nigeria

(received September 29, 2003; revised September 21, 2004; accepted September 30, 2004)

Abstract. Levels of cadmium, lead, zinc, copper and chromium were determined in the head, middle and tail regions of the silver cat fish (*Chryssichthys nigrodigitatus*). Water and sediments from three neighbouring man-made fresh water ponds were also analyzed using atomic absorption spectrophotometer. The mean concentration of these metals were found to be more in the soil, followed by the water and then the fish. The highest concentrations of zinc between 33.05-33.19 µg/ml and 39.72-40.13 µg/g, were found in the water and soil, respectively. Chromium concentration in water and soil ranged from 0.220-0.254 µg/ml and 0.335-0.347 µg/g, respectively. In the fish parts, zinc and chromium were found to be more in the head with values ranging from 19.05-19.23 µg/g and 0.210-0.215 µg/g, respectively. Cadmium, copper and lead were found to be more in the middle region, having values ranging from 0.260-0.261 µg/g, 4.60-4.62 µg/g and 0.320-0.321 µg/g, respectively. All metals investigated were consistently low in the fish tail. There was no significant difference in the mean concentration of all the metals in the three ponds at $p \leq 0.05$, while the distribution of the metals in the fish parts and between the fish and the water was significantly different at $p \leq 0.05$.

Keywords: trace metals, silver cat fish, soil sediments, atomic absorption spectrophotometer, *Chryssichthys nigrodigitatus*

Pak. J. Sci. Ind. Res. 2005 **48**(1) 42-46

Development of a High Yielding Wheat Variety "Bahawalpur-97" for Southern Punjab, Pakistan

Mushtaq Ahmad, Lal Hussain Akhtar*, S. Z. Siddiqi, Manzoor Hussain, A. Rashid, Ghulam Hussain, M. Aslam, M. Safdar, M. Masood Akhtar, M. Arshad and A. H. Tariq

Regional Agricultural Research Institute, Bahawalpur, Pakistan

(received April 19, 2003; revised July 5, 2004; accepted October 23, 2004)

Abstract. Studies were conducted to develop and release new improved wheat (*Triticum aestivum* L) varieties that can yield better and resist the diseases. On the basis of performance under field conditions, a line, MLT'S' (Metaltail)= ORE F1 158/FDI/Kl/BB/3/Nac, was selected from the Bread Wheat Observation Nursery MRA (1985-86), received through the courtesy of CIMMYT (Mexico) and given the No. V-7222. This line was tested/evaluated in 36 yield trials at different locations in Preliminary and Advanced Yield Trials (1986-89), Micro Wheat Yield Trials (1989-90) and National Uniform Wheat Yield Trials (1990-91 and 1991-92). On the average of 36 yield trials, Bahawalpur-97 gave 2.14, 5.94 and 1.22% higher yield than Inq-91, Pwz-94 and Pb-96, respectively. Its production technology was also developed. Its best sowing time was November to December. It gave maximum yield when NPK @ 125-100-50 kg/ha was applied. It was resistant to all foliar diseases. Its yield potential was 7200 kg/ha. This variety was approved and released by the Punjab Seed Council, Lahore, as a general-purpose variety for Southern Punjab in the name of "Bahawalpur-97" during 1998.

Keywords: wheat variety, disease resistance, Southern Punjab

Pak. J. Sci. Ind. Res. 2005 **48**(1) 47-50

Studies on the Lipolytic Enzymes of *Carica papaya* Seed Powder

M. Akhtar Javed*, Muhammad Naeem and Rana Amjad
PCSIR Laboratories Complex, Lahore-54600, Pakistan

(received October 2, 2003; revised October 10, 2004; accepted October 25, 2004)

Abstract. The lipolytic enzymes (lipase and phospholipase) extracted from the defatted seeds of *Carica papaya* showed optimum activity at 40 °C and pH 7 in aqueous media. *n*-Heptane was found to be the most satisfactory solvent to maximize activities of lipase and phospholipase. The activity of lipase extracted from germinated seeds increased with the stage of seed development, but the phospholipase activity was noted to decrease.

Keywords: *Carica papaya*, lipase/phospholipase activity, pH/temperature optima, triglycerides

Pak. J. Sci. Ind. Res. 2005 **48**(1) 51-54

Characterisation of Amidohydrolytic Activity of *Bacillus megaterium* in Submerged Fermentation

Quratulain Syed[a]*, Nasira Bashir[b] and Mohammad Akram Kashmiri[b]

[a]PCSIR Laboratories Complex, Lahore-54600, Pakistan

[b]Government College University, Lahore, Pakistan

(received January 7, 2004; revised August 5, 2004; accepted January 28, 2005)

Abstract. Cultural conditions for the production of penicillin amidohydrolase by *Bacillus megaterium* 5B were investigated in shake flasks. The extra-cellular amidohydrolytic activity of the strain after 24 h of incubation was 37 u/ml. The enzyme production was found to be affected by different carbon sources at different concentrations in the fermentation medium. The most suitable carbon source was sucrose at the concentration of 0.3% (w/v). The enzyme activity reached the maximum level (70 u/ml) with a cell mass of 3.1 g/l in 25 ml of the fermentation medium contained in 250 ml flask at pH 7 after 24 h of incubation.

Keywords: penicillin amidohydrolase, *Bacillus megaterium*, submerged fermentation

Pak. J. Sci. Ind. Res. 2005 **48**(1) 55-56

Short Communication

Mechanism of Monocarpic Senescence of *Momordica dioica:* Source-Sink Regulation by Reproductive Organs

Ashis Ghosh
Saraswati Vidyamandir, P.O. Midnapore, Dist. Paschim Medinipur, 721 101, W.B., India

(received February 25, 2003; revised September 13, 2004; accepted November 20, 2004)

Abstract. Average chlorophyll levels of male (♂) plants alongwith defruited plants of *Momordica dioica* were higher than female (♀) plants or monoecious plants. The order of senescence was as follows: ♀ > monoecious > ♂ > defruited. Protein content in the leaves and dry weight of aerial plant parts remained higher in ♂ as compared to defruited, ♀ and monoecious plants. Evidently, the absence of fruit was noted to delay senescence.

Keywords: chlorophyll, defruited plant, monoecious, protein, dry weight, *Momordica dioica*

Pak. J. Sci. Ind. Res. 2005 **48**(1) 57-58

Short Communication

Status of Grain Smut *Sphacelotheca sorghi* and Long Smut *Tolyposporium ehrenbergii* of Sorghum in Sindh and Balochistan, Pakistan

A. A. Hakro* and A. Khan
Crop Diseases Research Institute, SARC, PARC, Karachi University Campus,
Karachi-75270, Pakistan

(received July 31, 2003; revised October 10, 2004; accepted November 26, 2004)

Abstract. Survey of various parts of Sindh and Balochistan was conducted to determine the presence and distribution of *Sphacelotheca sorghi,* the causal organism of grain smut of sorghum. The percentage of disease in different localities of Sindh was 2% in Dadu, 0.5% in Piyaro Goth, 3% in Mehar, 3% in Nasirabad, 4% in Larkana, 8% in Kamber, 4% in Shahdadkot, 5% in Jacobabad, 5% in Thull, 6% in Kandhkot, 7% in Lakhi, 7.5% in Jehan Khan, 8.3% in Sukkur, 20% in Rohri, 15% in Ghotki, 15% in Mirpurmathelo, 15% in Ubaro, 20% in Daherki, 20.5% in Khairpur (Mir) and 17.1% in Karoondhi, and in localities of Balochistan was 7% in Nasirabad and in 7% Usta Mohammad. The incidence of long smut, *Tolyposporium ehrenbergii,* in Sindh was recorded at 0.2% in Dadu, 0.1% in Piyaro Goth, 0.5% in Mehar, 0.03% in Nasirabad, 0.6% in Larkana, 0.3% in Kamber, 1% in Shahdadkot, 1.2% in Jacobabad, 1.5% in Thull, 1.1% in Kandhkot, 1% in Lakhi, 1.3% in Jehan Khan, 1.5% in Sukkur, 3.5% in Rohri, 5% in Ghotki, 8.1% in Mirpurmathelo, 7.5% in Ubaro, 8.9% in Daherki, 9.1% in Khairpur (Mir) and 8% in Kroondhi, and in Balochistan was1.3% in Nasirabad and 1.4% in Usta Mohammad.

Keywords: grain smut, *Sphacelotheca sorghi*, long smut, *Tolyposporium ehrenbergii*, sorghum

Pak. J. Sci. Ind. Res. 2005 **48**(1) 59-62

The Dyeability Potential of Cellulosic Fibres Using African Yellow Wood *(Enantia chlorantha)*

A. O. Adetuyi*, A. V. Popoola, L. Lajide and M. O. Oladimeji
Department of Industrial Chemistry, Federal University of Technology, Akure, Ondo State, Nigeria

(received January 29, 2004; revised August 31, 2004; accepted September 2, 2004)

Abstract. The dye from African yellow tree, *Enantia chlorantha*, extracted by solvent extraction using acetone at a solute-solvent ratio of 1:25 was studied for its dyeability potential on cellulosic fibres. A golden yellow dye having a melting point ca 146-149 °C with 6.2% recovery was obtained. The dye was soluble in hydroxyl organic solvents. The cellulosic fibre has a greater dye uptake (26.0-23.2 mg/g) when dyed at a temperature of 80 °C than at 60 °C (22.0-21.6 mg/g). Its optimum dye-uptake, at both the temperatures, was achieved 90 min after the commencement of dyeing. However, the dyeability potential of the dye on unmordanted cellulosic fibres showed less substantivity as revealed by its low mean fastness ratings of 1.5 and 1.0 to washing and light, respectively. The tensile properties of the dyed cellulosic fibres, nevertheless, were greatly enhanced.

Keywords*:* Enantia dye, dye-uptake, *Enantia chlorantha,* African yellow wood

Pak. J. Sci. Ind. Res. 2005 **48**(1) 63-67

The Effect of Local Materials (Fillers) on the Crosslink Density, Hardness, Resilience and Hysteresis of Natural Rubber

B. F. Adeosun[a] and O. Olaofe[b]*

[a] Science Technology Department, Federal Polytechnic, PMB 5351, Ado-Ekiti, Nigeria

[b] Chemistry Department, University of Ado-Ekiti, PMB 6353, Ado-Ekiti, Nigeria

(received January 2, 2002; revised October 28, 2004; accepted November 2, 2004)

Abstract. This work reports the influence of local clay, charcoal, silica-sand, limestone and carbon black on the crosslink density, hardness, resilience and hysteresis of the natural rubber compound. The results revealed that all the fillers enhanced the crosslink density and hardness of the gum stock. Charcoal showed higher values of crosslink density, hardness and hysteresis than the other local fillers. At relatively low loading, local fillers showed appreciably higher resilience and slightly lower hysteresis than carbon black charcoal, being the least resilient and most hysteric. The present work suggests that the denser is the crosslink of the composite, the harder, less resilient and the more hysteric the composite becomes.

Keywords: crosslink density, hardness, resilience, hysteresis, carbon black, natural rubber composite

Pak. J. Sci. Ind. Res. 2005 **48**(1) 68-73

Preparation and Characterisation of Alkyd Resins Using Crude and Refined Rubber Seed Oil

E. U. Ikhuoria* and F. E. Okieimen
Industrial Agriculture Products Research Laboratory, Department of Chemistry, University of Benin, Benin City, Nigeria

(received February 19, 2002; revised December 7, 2004; accepted December 15, 2004)

Abstract. Six different alkyds were formulated with crude rubber seed oil 45% **(1)**, 50% **(II)** and 55% **(III)**; refined rubber seed oil 45% **(IV)**, 50% **(V)** and 55% **(VI)**; phthalic anhydride and glycerol. All the alkyds were formulated to alkyd constant of about 1.0. The alcoholysis method was used. Refining enhanced the quality of rubber seed oil in alkyd resin manufacture. The properties of the finished alkyd resins such as viscosity, number average molecular weights, drying schedule, chemical resistance and film hardness were determined. The intrinsic viscosity (η) was observed to be proportional to the number average molecular weight of the two sets of alkyd resins. However, samples **I-III** exhibited higher intrinsic viscosity in toluene than samples **IV-VI**. On the contrary, the films of samples **IV-VI** were harder, dried faster, and were more chemically resistant than those of samples **I-III**. The practical implications of these results are discussed.

Keywords: alkyd resins, rubber seed oil, refining, surface coatings, coating binders