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Some Common Fixed Point Theorems in Fuzzy 2-Metric Spaces

Sushil Sharma and Jayesh Kumar Tiwari

Abstract. The aim of this study was to prove some common fixed point theorems in fuzzy 2-metric spaces by removing the assumption of continuity, relaxing the compatibility or compatibility of type (α) or compatibility of type (β) to weak compatibility, and replacing the completeness of the space with a set of alternative conditions.

Keywords: fuzzy metric spaces, coincidence point, common fixed point, compatible maps, weakly compatible maps

Introduction

The concept of fuzzy sets was initially introduced by Zadeh (1965). Since then, for the purpose of using this concept in topology and analysis, many authors have expansively developed the theory of fuzzy sets and applications. Kaleva and Seikkala (1984), Deng (1982), Kramosil and Michalek (1975), and Erceg (1970) have particularly introduced the concept of fuzzy metric spaces in different ways. Recently, many authors have also studied the fixed point theory in these fuzzy metric spaces in different ways. Recently, many authors have also studied the fixed point theory in these fuzzy metric spaces, coincidence point, common fixed point, compatible maps, weakly compatible maps.

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Definitions

Definition 1.1. A binary operation *: [0,1] × [0,1] × [0,1] → [0,1] is called a continuous t-norm, if ([0,1], *) is an abelian topological monoid with unit 1 such that a * b ≤ c whenever a ≤ c, and b ≤ c for all a, b, c ∈ [0,1] (Sharma, 2002).

Definition 1.2. The 3-tuple (X, M, *) is called a fuzzy 2-metric space if X is an arbitrary set, * is a continuous t-norm and M is a fuzzy set in X x [0, 1] satisfying the following conditions:

(FM-1) M(x, y, z, 0) = 0,
(FM-2) M(x, y, z, t) = 1, t > 0 when at least two of the three points are equal,
(FM-3) M(x, y, z, t) = M(x, z, y, t) = M(y, z, x, t) = .... (symmetry about three variables),
(FM-4) M(x, y, z, t_1 + t_2 + t_3) ≥ M(x, u, z, t_1)* M(x, u, z, t_2)* M(u, y, z, t_3) (this corresponds to tetrahedron inequality in 2-metric space)
(FM-5) M(x, y, z, : [0, 1] is left continuous.

Example 1.1. Let (X, d) metric space define a *b = ab or a * b = min {a, b} and for all x, y ∈ X and t > 0

M(x, y, t) = \frac{t}{t + d(x, y)}

then:

(X, M, *) is a fuzzy metric space.
The Fe-Gd Phase Diagram

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(Received June 26, 2002; revised May 5, 2005; accepted May 12, 2005)

Abstract. The results of an experimental investigation of the iron-rich portion of the Fe-Gd system have confirmed previous studies showing that four incongruently melting intermetallic compounds exist, namely, Fe$_{17}$Gd$_2$, Fe$_{23}$Gd$_6$, Fe$_3$Gd and Fe$_2$Gd. The investigation also provided information about the crystal structures and ranges of stoichiometry of these intermetallic compounds.

Keywords: Fe-Gd phase diagram, Fe-Gd alloys, intermetallic compounds

Introduction

Transition metal-rare earth (TM-RE) alloy systems, both binary and higher orders, are of considerable interest in relation to the development of materials with attractive magnetic properties, such as large magnetostriction and high energy products. A characteristic feature of these TM-RE systems is the occurrence of a series of intermetallic compounds. The work reported here was part of a wider programme of research on certain binary and ternary transition metal-rare earth alloy systems (rare earths (RE) = Gd, Tb; transition metals (TM) = Fe, Co). The results on binary Fe-Gd alloys are specially reported here, which aim at resolving certain differences in previously reported studies.

Early work by Novy et al. (1961) reported seven intermetallic compounds with the Fe : Gd ratios of 17 : 2, 5 : 1, 4 : 1, 7 : 2, 3 : 1, 2 : 1, and 3 : 2. Another study (Savitskii et al., 1961) showed the presence of only four compounds, namely, 17 : 2, 23 : 6, 3 : 1, and 2 : 1. Other papers have been published on various aspects of this system including constitutional data, which have been the subject of several recent assessments (Zhang and Han, 1998; Okamoto, 1996; Savitskii et al., 1970). A reassessment has been also presented very recently (Zinkevich et al., 2000). This report incorporates a comprehensive list of references and also presents a thermodynamically calculated version of the phase diagram, which confirms the general features of the system and the four compounds reported by Savitskii et al. (1961).

The experimental results reported here are in general agreement with the assessment of Zinkevich et al. (2000). The stoichiometry ranges of the intermetallic compounds are also reported.

Materials and Methods

Alloys of nominal compositions, as listed in Table 1, were prepared as 5-10 g buttons by arc melting 99.99% purity iron and gadolinium under titanium gettered argon. Melting was carried out several times to ensure homogeneity. Samples of each alloy were subjected to homogenization heat treatment at 1050 °C for 2 weeks, followed by quenching in iced brine. Samples were sealed in evacuated silica tubes with partial pressure of argon prior to heat treatment.

Metallographic examination of both the as-solidified and homogenized samples, was carried out by optical and scanning electron microscopy. The composition of the phases appearing in various alloy samples was determined by energy dispersive X-ray (EDX) analysis with ZAF corrections. The compositions reported in Table 2 are the average of 5 measurements, the scatter was < ~0.5% and the error was ~±1% of the values reported. The X-ray diffractometry was carried out on powdered alloy samples employing Cu-Kα radiation so as to determine crystal structure and lattice parameter(s) of the compounds by applying the Nelson-Riley function.

Table 1. Nominal compositions of the Fe-Gd alloys investigated

<table>
<thead>
<tr>
<th>Alloy designation</th>
<th>Fe (atomic, %)</th>
<th>Gd (atomic, %)</th>
</tr>
</thead>
<tbody>
<tr>
<td>GF-5</td>
<td>95.0</td>
<td>5.0</td>
</tr>
<tr>
<td>GF-11</td>
<td>88.5</td>
<td>11.5</td>
</tr>
<tr>
<td>GF-13</td>
<td>86.5</td>
<td>13.5</td>
</tr>
<tr>
<td>GF-16</td>
<td>83.4</td>
<td>16.6</td>
</tr>
<tr>
<td>GF-22</td>
<td>78.0</td>
<td>22.0</td>
</tr>
<tr>
<td>GF-25</td>
<td>74.5</td>
<td>25.5</td>
</tr>
<tr>
<td>GF-33</td>
<td>66.5</td>
<td>33.5</td>
</tr>
</tbody>
</table>

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Effect of Sodium Chloride on Dissolution of Galena in Aqueous Acid Solution

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(received June 3, 2004; revised March 22, 2005; accepted March 25, 2005)

Abstract. This paper presents the results obtained on the kinetic study of non-oxidative dissolution of natural galena in aqueous hydrochloric acid with the addition of sodium chloride. A chemical reaction on the surface of galena controlled the dissolution rates under the experimental conditions of investigation. The galena dissolution rate was of the first order with respect to hydrochloric ion activity in hydrochloric acid solution. The addition of sodium chloride to the acid solution greatly enhanced the dissolution rate. The effect of sodium chloride has two possible interpretations: firstly, it may be the result of an increase in the hydrogen ion activity; secondly, the enhancement of the dissolution rate, observable at the high sodium chloride concentration, may be due to the specific absorption of chloride ions or the surface complexing of chloride ions on galena surface.

Keywords: dissolution mechanism, kinetics of galena, effect of sodium chloride, non-oxidative dissolution, galena dissolution rate

Introduction
Non-oxidative dissolution of the base metal sulfide in acidic solution has been studied in order to understand the leaching kinetics and to develop suitable conditions for a non-oxidative leaching method for the treatment of base metal sulfide ores. The kinetics of sphalerite in sulfuric acid solutions, with and without the addition of sodium chloride, have been reported (Eguchi et al., 1982). These authors noted that addition of sodium chloride to the sulfuric acid solution containing zinc ions greatly enhanced the dissolution rate which depended on the concentration of zinc ions. Tarabaev and Milyutina (1956) studied the kinetics of the dissolution of synthetic and natural sulfides of lead, copper, zinc and iron in sulfuric acid solutions containing chloride ions. They reported that sulfides of base metals dissolved most readily in these solutions. Scott and Nicol (1976) also studied base metal dissolution in concentrated chloric acid solutions and proposed a general model for the diffusion-controlled dissolution. On the contrary, Awakura et al. (1980) proposed that base metal dissolution in concentrated acid solution is controlled by the first order chemical reaction. Nunez et al. (1990; 1988) reported that the order of reaction for ionic activity of HClO₄ is of the first order, whereas for HCl the order of reaction over a wide range of concentration is 3/2 with respect to mean ionic activity of hydrochloric acid. They also reported that activation energy is independent of the chloride ion used to increase the activity of HCl. Mackovich and Pitsyn (1999) studied the leaching kinetics of galena with a mixture of nitric acid and sulfuric acid. They observed a dependence on the content of H₃SO₄ in the presence of the leaching agent HNO₃ which had a catalytical effect, thus increasing the oxidation rate of galena to two times even at a very low concentration (0.01 mole per litre). These kinetic studies are, however, insufficient to explain the mechanism of dissolution of galena in acidic solution. It was, therefore, considered appropriate to reinvestigate the kinetics in order to better understand the dissolution of galena in acidic solution. This paper thus presents the results of a kinetic study on non-oxidative dissolution of galena in hydrochloric acid with the addition of sodium chloride.

Materials and Methods
Materials. A natural galena sample, having a composition of 85.54% Pb and 14.46% S, was used in this study. The main impurities identified by spectrographic analysis were silica and silver. The sample was mounted in such a way that only a cleavage face of galena was introduced to a dissolution medium. The galena surface was ground with corundum number 1500 and then polished with fine alumina. Distilled and deiodized water with the average specific conductivity of 10⁷ Ω/cm was used in all the experiments. Hydrochloric acid solution of the desired concentration was prepared by diluting the standard IM HCl solution. Nitrogen gas was used for deoxygenation of the solution and purging of the reactor. All chemical reagents used were of Analytical grade.

Experimental procedure. A 500 ml separable glass flask, with lid having four necks was used as the reaction vessel for
Separation of Close Boiling Acidic Isomers by Dissociation Extraction

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Abstract. The separation of m-cresol and p-cresol was studied using dissociation extraction technique. The separation factors obtained for cresols-carbon tetrachloride-caustic soda system were in the range of 1.40 to 1.52, whereas for cresols-carbon tetrachloride-monoethanolamine system were in the range of 1.297 to 1.417. Isomer ratios, concentration of cresols and the strength of aqueous extractant have a significant influence on the separation of cresols. The organic acid (m-cresol) was successfully back-extracted from aqueous caustic soda with a non-polar organic solvent, octanol. pH of the aqueous phase and the choice of organic solvent have an important role in the back-extraction of m-cresol.

Keywords: dissociation extraction, cresols, monoethanolamine, isomer separation, close-boiling isomers

Introduction

The coal-tar produced in steel industries on carbonization of coal contains industrially important phenolic compounds (Michael and Muder, 1974). These are used as intermediates, or starting compounds, for the production of dyes, herbicides, pesticides, medicines, and several other useful chemicals (Hutton et al., 2000; Lo and Baird, 1996; Anwar et al., 1995). These phenolic compounds cannot be separated by the well established unit operations, as they exhibit normal boiling points, differing by only a fraction of a degree and having similar solubilities in most solvents. However, the difference in molecular arrangements of the isomers does result in an appreciable difference in their strength as acids or bases, as shown by their relative dissociation constants, which are 9.8x10^{-11} for m-cresol, 6.7x10^{-11} for p-cresol, 4.54x10^{-9} for 3-picoline and 10.62x10^{-9} for 4-picoline. This difference is being exploited as the basis of practicable separation by the less known process of dissociation extraction. The basic principles of dissociation extraction were reported by Warnes (1924), long before the term “dissociation extraction” was suggested (Twigg, 1949). The commercial applications of dissociation extraction technique, based on the earlier studies (Pratt, 1967; Wise and Williams, 1964), were impeded by the continuous consumption of strong bases or strong acids for the recovery of phenolic compounds. This was due to the difficulty in reversing the reaction in order to free the purified isomer, as well as to regenerate the extractant. Ideally, there should only be a weak interaction between the extractant and the desired isomer, yet sufficiently strong to achieve the separation but weak enough to be broken-down without using excessive chemicals, or thermal energy. Considering this, weak acids and bases (organic and inorganic) in water were successfully used as extractants (Anwar et al., 1979; 1971). These studies also provided the theoretical basis for such applications. The findings reported in these studies prompted Sharma and coworkers (Pahari and Sharma, 1992; Gaikar and Sharma, 1987; Wadekar and Sharma, 1981) to study other weak acids and bases for the separation of close boiling substances using the dissociation extraction technique.

In the dissociation extraction process, the weakly acidic or basic organic or inorganic compounds may be used as extractants as long as they are preferentially soluble in the aqueous phase (Ahmed et al., 2002; Anwar et al., 1979), and insoluble in the organic solvent. Earlier work (Ahmed et al., 2003) established that aqueous sodium dihydrogen phosphate, a weak acid, could be used successfully to separate the mixture of 4-picoline and 3-picoline. Although experimental results confirmed the viability of the process, the low separation factors and aqueous phase loadings of picoline implied that a liquid-liquid extraction contactor, with a large number of stages, is required for the desired results.

To illustrate the principles of dissociation extraction, let us consider a mixture of weak organic acids, m-cresol and p-cresol obtained from the coal-tar distillate. These, in the organic diluent, are partially neutralized by an aqueous weak organic base, such as monoethanolamine, C_6H_5(NH_2)OH. There will thus be a competition between the two organic acids to react preferentially with the aqueous organic base. The organic acid (m-cresol), having higher dissociation constant, will react preferentially with the base to form an ionized salt in the aqueous phase, insoluble in the organic phase. The other organic acids (p-cresol), having a lower dissociation constant, will remain predominantly in its un-
Determination of the Level of PCBs in Small Fishes from Three Different Coastal Areas of Karachi, Pakistan

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(received March 31, 2004; revised December 2, 2005; accepted January 5, 2005)

Abstract. The level of congener polychlorinated biphenyls (PCBs) was determined in small fishes. These fishes were collected from the beaches of Korangi Creek, Hawksbay and Clifton, all located in Karachi, Pakistan. The contamination status of PCBs was followed by their concentration in tissues. Higher PCBs were found to be the most persistent organopllutants, present in all the fishes studied. The samples were spiked with 5µl surrogate internal standard solution containing IUPAC numbers 194 and 198. A total of 14 PCBs were screened in each sample. The concentrations of PCBs found were 1.25 ± 0.02 ng/g dry weight of fishes collected from Clifton, 1.01 ± 0.52 ng/g of fishes collected from Hawksbay, and 1.00 ± 0.43 ng/g of fishes collected from Korangi Creek. The congener PCBs 138,153, and in some small fishes 118, were found to be predominant among all the PCBs tested in this study.

Keywords: organic pollutants, PCBs, small fishes, Karachi coast, polychlorinated biphenyls

Introduction
The coastline of Karachi, Pakistan, stretches along the shores for about 135 kilometers. Its growing pollution level is not only due to the increasing volume of trade via the shipping routes through the Karachi port, but is also due to its intake of toxic effluents from a number of industries. This is severely contaminating the mangrove forests and the marine life in the area. The use of polychlorinated biphenyds (PCBs) in Pakistan is mainly for industrial purposes. PCBs are the mixture of upto 209 individual chlorinated compounds and are classified as persistent organic pollutants (Langanathan and Kannan, 1991). They are used in the manufacturing of electrical equipment, heat exchangers, hydraulic systems, and several other specialized applications. PCBs do not readily breakdown in the environment and thus remain there for a very long period of time. PCBs may enter the air, water and soil. In water, a small amount of PCBs may remain dissolved, but most of it sticks to the organic particles, bottom sediments, and binds strongly to the soil. PCBs are taken-up by small organisms and fishes through the contaminated water and may thus get into the food chain of other animals. Through the food chain, therefore, PCBs accumulate in fishes and marine mammals, reaching a level that may be immensely higher than that in the surrounding water. The consumption of PCBs is hazardous as these are suspected to be human carcinogens (CEPA, 2003; ATSDR, 2000).

There are no known natural sources of PCBs, but these have been regularly found in fishes, wildlife, and humans (Erickson, 1997). Earlier studies on fish have indicated that PCBs are unlikely to affect the growth of cultured fish at concentrations typically found in the environment (Kan-Atirek, 1997; Duinker et al., 1980). Commercially produced fish feeds often contain low concentrations of PCBs. However, cultured fish biomagnify PCBs from feeds, resulting in their concentration in the fish tissue to exceed that of fish feed itself (Carlne et al., 2004). The U.S. Food and Drug Administration (US-FDA) has set the tolerance level of 0.2 ppm (200 ng/g) of PCBs in the finished fish feeds and 2.0 ppm in the fish sold for human consumption.

The objective of the present study was to provide baseline data on organochlorine concentrations in the fishes commonly consumed as food in Karachi. Samples for the present study were collected from three different locations along the Karachi coast.

Materials and Methods
Sampling locations. The sampling locations included Korangi Creek, Hawksbay and Clifton (Fig. 1). Korangi Creek is situated in the South of Karachi, encircled by muddy creeks. This creek receives effluents from industries and oil refineries. The creek accommodates a few channels used by fishermen (Beg et al., 1984). A long stony wall lies on the East of Hawksbay, receiving intake of effluents, particularly oil, released during loading and unloading of the oil from tankers. Slicks and tarry deposits were observed during the collection of samples from this area. Clifton is one of the sandy shores where fauna is extremely rich and seems to be rather free of pollution. Water currents may, however,
Laboratory Evaluation of Plant Extracts as Antifeedant Against the Lesser Mealworm, *Alphitobius diaperinus* and Rice Weevil, *Sitophilus oryzae*

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**Abstract.** Studies were conducted on leaf, seed and bark extracts (acetone, ethanol and water) of *Ipomoea fistulosa*, *Datura fastuosa*, *Eucalyptus citridora*, *Helitropium indicum*, *Hedyotis corymbosa* and *Sapium indicum* for their antifeedant effects against the lesser mealworm, *Alphitobius diaperinus* and rice weevil, *Sitophilus oryzae*. The results showed that all the plant extracts had antifeedant effect on both the insects. Among the six plant extracts tested, *Sapium indicum* extracts had the highest antifeedant effect on the lesser mealworm and rice weevil. The ethanol extracts of leaf and seed were more effective than those obtained in the other two solvents. The coefficient of deterrency increased proportionally with increase in doses. The seed extract was more effective than leaf extract.

**Keywords:** plant extracts, antifeedant, lesser mealworm, rice weevil, *Alphitobius diaperinus*, *Sitophilus oryzae*

**Introduction**

Insect infestation in stored grains and their products is a serious problem throughout the world. Approximately, 200 species of insects and mites attack stored grains and stored products (Maniruzzaman, 1981). Among these species, the lesser mealworm (*Alphitobius diaperinus*) and rice weevil (*Sitophilus oryzae*) are the most common and destructive pests. Chemical control of insects during storage has been in practice for a long time, but it has serious drawbacks (Sharaby, 1988). Indiscriminate use of chemical insecticides has given rise to many serious problems, including genetic resistance in pest species, toxic residues, increasing costs of application, environmental pollution, and hazards to human beings and animals during its handling and afterwards (Khanam et al., 1990; Ahmed et al., 1981). This situation is indicative of the need for safe, locally available and less expensive materials for pest control during storage. Locally available plants and minerals have been widely used in the past to protect stored products against insect infestations (Golob and Webley, 1980). The advantages of botanical products for this purpose are that they are less expensive, non-hazardous and can be easily produced by farmers. In the rural areas of South-Asia, including Bangladesh, farmers traditionally mix leaves, barks, seeds, roots or oils of certain plants with stored grains to protect them from insect attacks. The use of antifeedants obtained from indigenous plants in plant protection is still in the experimental stages in Bangladesh. Very little work has been reported on their efficacy against insect pest (Shahjahan and Amin, 2000; Akhtar et al., 1998). The present study was undertaken with some locally grown plants, such as *Ipomea fistulosa* (vern. dholkalmi), *Datura fastuosa* (vern. datura), *Eucalyptus citridora* (eucalyptus), *Helitropium indicum* (vern. hatisur), *Hedyotis corymbosa* (vern. khetpapi) and *Sapium indicum* (vern. urmoi) to investigate their compatibility with the pest management programme by determining their antifeedant effects against *Alphitobius diaperinus* and *Sitophilus oryzae*.

**Materials and Methods**

The present studies were conducted on the evaluation of some plants for their antifeedant effects against the lesser mealworm, *Alphitobius diaperinus* and rice weevil, *Sitophilus oryzae* in the laboratory of the Department of Entomology, Bangladesh Agricultural University, Mymensingh during the period from July 1999 to June 2000. The test insects were reared separately in plastic jars (12.0 x 23.0 x 6.5 cm). The lesser mealworms were fed on wheat grains and rice weevils on rice grains. The jars were kept in laboratory at 18.70-28.9 °C temperature and 73.34-87.90% relative humidity.

**Preparation of plant extracts.** The plant samples (leaf, seed, bark) of “dholkalmi”, “datura”, eucalyptus, “hatipur”, “khetpapi” and “urmoi” were collected from different areas of Bangladesh. Fresh leaves, seeds and barks of these plants were washed with water, air-dried, and followed by drying in oven at 60 °C. The dried plant samples were ground manually and passed through a 25-mesh sieve to obtain fine powder of each plant part. The powders were preserved in airtight containers. Thirty grams of the fine powder of each plant sample was taken in a 600 ml beaker to which were separately added 300 ml of different solvents (acetone, ethanol and water). The

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Quantification of Bactericidal Action of the Ethanolic Extract of *Garcinia kola* Seeds Alone, and in Combination with the Branded Antibiotic Septrin, on the Culture Isolates from Throat Irritation Patients by Bacterial Growth Kinetics

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**Abstract.** The relationship of growth rates of *Streptococcus pyogenes*, isolated from patients with protracted throat irritations and tonsillitis, with *Garcinia kola* extract and the branded antibiotic Septrin was investigated. A steady state was obtained shortly after the addition of Septrin, whereas a lag phase of about five generations elapsed for *G. kola*. The inhibitory effect of Septrin was about five times greater than the effect of *G. kola*. The inhibitory effect of *G. kola* was only bacteriostatic, whereas Septrin caused bacterial death if a certain threshold of concentration (1 mg) was passed, as evidenced by a decrease in the number of bacterial cells. Combination of Septrin and *G. kola* at concentrations where both acted merely bacteriostatically, led to effects considerably greater than would be expected from simple additivity. It is justifiable to conclude that the combination of *G. kola* extract and Septrin had a synergistic effect.

**Keywords:** *Garcinia kola*, antibiotic Septrin, bacterial growth kinetics, ethanolic extract, antibiotic synergism, antibiotic Septrin, *Streptococcus pyogenes*, throat irritation

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**Introduction**

*Garcinia kola* (bitter kolanut), Family Guttiferae, is a native of Southwestern African countries where it grows wild. It has not attracted the due attention of plant breeders to cultivate it and improve the wild strain. The plant, however, has gained recognition in Western Africa, though it is not a crop of commerce (Irvine, 1963). Its fruit is normally about 7.5 cm in dia and contains 4 to 6 light brown seeds embedded in the pulp. *G. kola* is a popular seed, eaten on social and other occasions in most parts of Western African countries and is an important ingredient in medicinal preparations (Nwafor and Ogbeneaga, 1992). In some parts of Africa, however, the seeds are believed to cause impotency in man. The nuts are eaten raw as a stimulant to resist hunger and sleep (Adeyeye and Ayejuyo, 1994), and also used for the treatment and management of cough and asthma (Nwafor and Ogbeneaga, 1992). The root cuttings are used as chewing stick and for medicinal purposes, such as in the treatment of cough.

The antibiotic Septrin (30 mg trimethoprim and 400 mg of sulfamethaxazole) is effective against a wide range of gram-negative and gram-positive bacteria (Hitchings, 1967). Septrin is indicated for the treatment of bacterial infections of the respiratory tract, urinogenital tract including gonorrhea, prostatitis, gastrointestinal tract (typhus, paratyphus, cholera), skin and soft tissues, and those following surgical and stomatological interventions. A potentiating effect of Septrin on *Garcinia kola* (or vice versa) has been reported, presumably due to the sites of action of the inhibitors being at different steps in the same biosynthetic pathway (Nwafor and Ogbeneaga, 1992). Although the combination of Septrin with *G. kola* is extensively used, there are no reports on the quantitative biochemical effects of such uses, as related to chemotherapeutics. Earlier studies have shown the synergistic action of the drug combinations, using serial-dilution techniques, disc-sensitivity test, or experimental infections in animals (Burchall, 1969). In addition to the differences in the definitions of synergism and additivity of the drug action among various authors/workers (Garrett and Brown, 1993; Garrett, 1978a), these methods do not seem practicable for the quantification of the chemotherapeutic effect. A linear relationship between inhibition and the inhibitor cannot be presumed and should not be expected to exist. In addition, the additivity of killing of the numbers of bacteria is not necessarily synonymous with an additivity rate of constants for the killing of bacteria. Diffusion of drugs in culture experiments may not be independent of other laboratory factors, thus resulting in a false presumption of synergy of antibacterial action (Toama et al., 1978), while experiments with live-animals may perhaps relate best to the clinical effects of the combination, these may show synergy as a re-

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Assessment of the Safety of Wild Strains of *Lactobacillus* as Probiotics Orogastrically Administered to Rats

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**Abstract.** The safety of four wild strains of *Lactobacillus*, isolated from fresh cow milk and faeces of albino rat (*Rattus norvegicus*) was studied. Some biochemical parameters of the serum in the orogastrically-dosed rats were used as the index. A reduction in the levels of serum cholesterol and of serum aminotransferases in the rats orogastrically-dosed with *Lactobacillus* isolates, as compared with the control group was noted. There was no significant difference (P > 0.05) in the alkaline phosphatase levels of the control and the orogastrically-dosed rat groups. Serum globulin and bilirubin levels showed a significant difference (P < 0.05) among the control and the *Lactobacillus*-dosed groups. The control group recorded the highest weight gain among all the groups studied, but it was not significantly different (P > 0.05) from other treatments except in the rats dosed with the *Lactobacillus casei* strain isolated from cow milk. The rats dosed with *Lactobacillus* displayed beneficial effects as probiotics in terms of reduced serum cholesterol and liver function improvement in terms of reduction in the serum aminotransferase levels.

**Keywords:** *Lactobacillus* isolates, serum cholesterol, albino rats, cow milk, probiotics, *Lactobacillus* safety

**Introduction**

Probiotics are the food supplements containing viable microbes, which have the potential to beneficially influence the health of the host (Schrezenmeir and De Vrese, 2001). Metchnikoff (1907) observed, at the beginning of the last century that the consumption of fermented foods was helpful in controlling autointoxication caused by the putrefactive microbial species that produce toxic compounds in the intestine. Attempts have been made to replace this putrefactive microbiota with the saccharolytic species. *Lactobacillus*, *Streptococcus*, and *Bifidobacterium* species have been found to play a useful role in this respect (Fuller, 1989). Species belonging to *Lactobacillus* have been reported to play an important role in the maintenance of the intestinal ecosystem (Sandine, 1979). These organisms have been shown to possess antagonistic effect towards the growth of pathogenic bacteria, such as *Listeria monocytogenes*, *Escherichia coli*, and *Salmonella* spp. (Drago et al., 1997; Chateau et al., 1993; Ashenafi, 1991). The inhibitory properties of the *Lactobacilli* have been linked with metabolic products, such as organic acids (mainly lactic acid), hydrogen peroxide, and bacteriocins (Juven et al., 1992).

An essential determinant in the choice of a probiotic microorganism is its ability to reach, survive, and persist in the environment in which it is intended to act (Marteau et al., 1992). Some workers have demonstrated the survival and temporary colonisation of the human gastrointestinal tract by some lactic acid bacteria (Jacobsen et al., 1999; Alander et al., 1997). Walker and Duffy (1998) pointed out that the current perspective on biotechnical applications of probiotic products requires further *in vitro* and *in vivo* investigations to evaluate the safety of using wild-type organisms, or those obtained by genetic engineering. The safety and health promoting effect of *Lactobacillus casei* isolated from different sources, mainly the European cheeses, have been reported by using biomarkers of serum and faeces (Bertazzoni et al., 2001). The relationship between diet and disease/health can be revealed by these biomarkers, since they provide a link between the consumption of specific foods and the biological outcome (Branca et al., 2001). Major biomarkers, such as plasma enzymes, and their changes during the disease are related in many ways to cell pathology (Baron et al., 1994). The aim of the present study was, therefore, to assess the safety of wild strains of *Lactobacillus*, isolated from fresh cow milk and faeces of albino rats, when orogastrically-dosed to rats using biochemical markers in the serum as the index.

**Materials and Methods**

*Lactobacillus* cultures. Four *Lactobacillus* strains, isolated from fresh cow milk and faeces of albino rats, were used in the present study (Table 1). These isolates were characterised using the colony, morphological and biochemical characteristics. The isolates were observed to show antagonistic effects against some pathogens and had the ability to adhere...
Restriction to Root and Shoot Growth Limits Their Growth Rates and Changes the Morphology of Cotton Seedlings During Emergence

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Abstract. Pre-germinated cotton seedlings were grown under laboratory conditions to determine the affect of root and/or shoot impedance on their growth. The treatments studied were: (i) both shoot and root unimpeded, (ii) shoot impeded and root unimpeded, (iii) root impeded and shoot unimpeded, and (iv) both root and shoot impeded. Impeding the root alone, or root and shoot together, significantly (P < 0.05) reduced axial root length, total root length, and increased root diameter. The axial root length was reduced by 55%. The number of root laterals was not affected by impedance but lateral spacing was reduced significantly. Root diameter was increased in treatments where only roots had been impeded. Shoot diameter was significantly (P < 0.05) greater in the root and shoot impeded treatments. Shoot length was reduced by 15% when only the shoots were impeded, while 38% reduction was noted when both root and shoot were impeded. Shoot impedance did not cause any significant effect on the root growth rate when roots were unimpeded. In terms of shoot length, root impedance had no effect on shoot length, although the combined effect of root and shoot impedance was greater than shoot impedance alone.

Keywords: mechanical impedance, root/shoot length, root/shoot diameter, restricted root elongation, root development

Introduction

The development of a root system capable of anchoring the shoot and the ability to uptake sufficient water and nutrients from the soil is essential for the survival of most terrestrial plants. The root zone soil constraints prevent the development of root system and eventually the crop yield (Rengasamy and Vadakattu, 2002). The growth of roots and shoots are often slower when plants are grown in soil of large bulk density (Voohees, 1992). In such soils, various physical (availability of oxygen and water, and mechanical impedance) and biotic factors may limit root and shoot growth. However, the mechanical impedance (resistance pressure encountered by growing roots) of the soil is often the single most important factor that can limit root and shoot elongation. It increases with the increase in soil dry bulk density (e.g., due to compaction) and also increases as the soil matric potential decreases. Unless roots are able to exploit the soil structural features, their growth rate is reduced as mechanical impedance is increased (Townend et al., 1996). Clark et al. (2001) showed that pea roots are capable of sensing a partial increase in mechanical impedance that can increase the turgor of seedlings but there was still some reduction in root growth. In natural conditions, plant roots invariably encounter some degree of mechanical resistance to their penetration through the soil.

It used to be generally believed that roots are unable to penetrate into rigid pores that were narrower than their normal diameter. More recent studies have revealed that roots can grow into rigid pores that are smaller than their diameter (Bengough et al., 1997). In soils, roots can often exploit cracks, voids and larger pores, or enlarge smaller pores by displacing soil particles. On encountering mechanical impedance, root cell division and elongation are decreased (Eavis, 1967). Root diameter just behind the apex can increase and the production of lateral roots may also be increased, with laterals emerging closer to the apex (Atwell, 1988; Goss, 1977). Restricting the soil volume explored by roots reduces shoot growth (Young et al., 1997; Passioura, 1991; Carmi and Heuer, 1981). This is often accompanied by an increased root : shoot mass ratio (Cook et al., 1996; Blaikie and Mason, 1993). Slower shoot growth of wheat seedlings was reported in compacted soils while plants were still in the seed reserve-dependent growth stage (Nabi and Mullins, 2001; Masle et al., 1990). Dawkins et al. (1983) observed smaller shoot : root ratio in peas when roots were growing in compacted than in loosened soil. Masle and Passioura (1987) grew wheat seedlings for 22 d in small cores of compacted soil and found that shoot growth and development were severely restricted. Andrade et al. (1993) also found that strong soil affected shoot growth early in sunflower. Montagu et al. (2001) found that soil compaction decreased root growth in broccoli.

Roots experience mechanical impedance as they elongate in the soil and the decrease in their growth rate is due to the force required to displace soil particles. Strong soil can be a...
Evaluation of Nutritive Properties of the Large African Cricket 
(*Gryllidae* sp)

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Abstract. The large African cricket (*Gryllidae* sp) was subjected to standard analytical procedures to determine its proximate composition, functional properties, amino acids spectrum, *in vitro* protein digestibility, and nutritionally valuable minerals. The moisture was low (2.13-3.48%), while the protein content was high (65.95%) in the male cricket and 65.11% in the female cricket. Seventeen amino acids were detected. The essential amino acids contributed 46.1-47.8% of the total amino acid content. Results of the *in vitro* protein multienzyme digestibility indicated high digestibility (90.7-94.7%). The amino acids scores were also favourable. The crude fibre and fat contents were fairly high, while the total carbohydrates were low (8.26-12.49%). The carbohydrates fraction contained 85.9-88.0% carbohydrates as stored glyco- gen. Phosphorus was the highest mineral in the ash (180.92 mg per 100 g), while the concentration of zinc was the lowest (1.46 mg per 100 g). Copper, manganese, nickel and lead were below the detection limits. Observations on the functional properties revealed low gelation, oil absorption, and emulsion capacity and stability. The effect of pH on the protein solubility showed that the lowest solubility occurred at the pH value of 4.0, while maximum solubility was recorded at the pH values of 6 and 7.

Keywords: *Gryllidae* sp, nutritional properties, functional properties, large African cricket, new protein source, *Gryllidae* amino acids

Introduction

The large African cricket (*Gryllidae* sp) is one of the most notorious and highly destructive pest of many economic crops in the Western, Central and Eastern parts of Africa (Daramola, 1974). Several authors have observed that this pest attacks animals, herbs and plantation crops at their nursery stages (Hewuirt, 1980; Daramola, 1974; Kaufmann, 1965; Chapman, 1962). This field cricket has been reported to feed on a wide variety of food plants, such as banana, and tea and coffee seedlings (Toye, 1982), and some commercial crops, including *Amaranthus* sp, *Rosa* sp, *Mangifera indica, Theobroma cacao* and *Cola* sp. The female insects, which have an elongated banana-shaped abdomen, lay eggs in batches, approx 2000 eggs in a batch. At room temperature (30±2 °C), the eggs hatch in 10-12 days. The development of the nymphs takes 40-60 days. The adults, which generally live for 2 to 3 months, are omnivorous. The crickets grow up to 2-3 inches in length. The females have long ovipositor, about 18 mm in length.

In view of the nutritive properties of similar insects, a study on the chemical composition of the large African cricket was given consideration. These studies aimed at solving two problems. Firstly, to reduce the destructive effects of this insect in terms of reduction in their population size to alleviate the problem. Secondly, to overcome the problem of shortage of high quality protein sources and the prevalence of protein malnutrition in the developing countries. It was against this background, that the nutritional properties of the adult male and female large African cricket (*Gryllidae* sp) was investigated.

Materials and Methods

Materials. The adult male and female crickets (*Gryllidae* sp) were collected during the wet season (April to August), when their population is at the peak. They were collected from Ibadan, Ile-Ife, Ilesa, Akure, Iseyin, Tede and the entire South-western Nigeria. The insects were demobilised by asphyxiating them in deep freezers at - 20 °C. Their alimentary canals were carefully removed and the samples subsequently dried to constant weight in an oven at 40 °C. The dried samples were pulverised into fine powder using a Christy laboratory mill. The samples were stored in dry air-tight plastic containers at 4 °C.

Analytical methods. Proximate analysis of the samples for moisture, crude fibre, protein and ash contents was carried out according to AOAC (1990). Carbohydrate fractions were
Prevalence of Intestinal Helminth Parasites of Dogs in Lagos, Nigeria

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Abstract. A survey of 310 dogs (164 males and 146 females) for infections with intestinal helminth parasites was carried out in Lagos, Southern Nigeria. Out of these, 175 were pet dogs and were routinely checked by veterinary doctors, while the remaining 135 were stray dogs, which did not receive medical check-up. Stray dogs were significantly more infected (77.8%) than the pet dogs (12.0%) at P < 0.01. The analysis of infection pattern, by age, revealed that among the stray dogs, 92.2%, 76.6% and 59.5% of the puppies, young and adult dogs, respectively, were found infected. Corresponding prevalences among the pet puppies, young and adult dogs were 21.5%, 7.1% and 5.0%. Helminth ova recovered from the stray dogs included *Toxocara canis* (47.6%), *Ancylostoma caninum* (41.9%), *Dipylidium caninum* (37.9%) and *Trichuris vulpis* (20.9%). Helminth ova recovered from the care-receiving dogs were *Toxocara canis* (5.8%), *Ancylostoma caninum* (3.2%) and *Dipylidium caninum* (2.1%). Female stray dogs, with a prevalence of 89.7%, were significantly more infected than their male counterparts (70.9%). Stray puppies, with an infection rate of 92.2%, were significantly more infected than stray young and adult dogs. Public health implications of these results, with particular reference to zoonotic transmission, was highlighted.

Keywords: intestinal helminths, dog intestinal parasites, helminth ova, infected stray dogs, helminths of dogs

Introduction

Dogs have remained among the closest associates of human beings since ancient times. The usefulness of dogs for hunting, anti-crime and security purposes, food, religious rituals, and as companion have endeared them to man. However, in spite of the listed usefulness, the dogs, especially the free-roaming types, have been incriminated in the transmission of zoonotic diseases, such as cutaneous larva migrans (Dryden, 2002; Schantz, 2002; Kagira and Kanyari, 2000; Kazacos, 2000; Burnham, 1998; Blagburn et al., 1997; 1996; Hendrix et al., 1996). There is paucity of data on the endoparasites of dogs in Nigeria. The existing information is limited to the studies carried out in Ibadan (Olufemi and Bobade, 1979; Idowu et al., 1977; Oduye and Olayemi, 1977; Oduye and Otesile, 1977), in Zaria (Dada and Belino, 1979; van veen Schilhorn and Adeyanju, 1979), and in Abeokuta (Mafiana et al., 1993). Legislation on the free-roaming types is not enforced in Nigeria. The flooding of Nigerian towns and streets with these animals, therefore, continues unabated. The objective of the present study was to determine the prevalence of helminth parasitic fauna of dogs in the Lagos area, thus adding to the existing information. Enumeration of the dangers associated with free-roaming dogs and the strategy to promote public enlightenment on the dangers of stray dogs are highlighted. The need to emphasize medical attention for domestic animals, by taking them for appropriate veterinary care, is suggested.

Materials and Methods

Some private houses located in different parts of Lagos city were visited to solicit the cooperation of dog owners. These dogs were given serial numbers, and the information on their age, sex, breed, degree of restriction and the type of treatment each dog had received during the last one year was obtained. Faecal collections of the dogs that had strayed and received no treatment for the past one year and of the non-strayed dogs kept under medical care were obtained. For the ease of collection and for obtaining fresh samples, the city was divided into sections. The schedule of faecal collection was conveyed to each section, prior to the day of visit by the official. Dog owners were asked to restrict their dogs at night before the day of visit. This ensured that the faeces collected corresponded to the dog for which information was obtained. Faecal samples of 135 free-roaming dogs were obtained. Some private veterinary clinics were contacted and faecal samples of 175 non-roaming dogs, brought-in for routine check-up, were obtained. Relevant informations, as stated above, were obtained for each dog. For both groups of dogs, efforts were made to examine the faecal samples immediately after collection. Whenever not feasible, however, samples were refrigerated and examined within two days. Information was obtained.
Correlation and Path Analysis in Candidate Bread Wheat (*Triticum aestivum*) Lines Evaluated in Micro-Plot Test Trial

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Abstract. Correlation and path analysis among yield and yield-associated traits of eight candidate bread wheat lines, including two check varieties, were studied during 2001-02. All the characters studied differed significantly from each other, except biological yield and harvest index. Positive genotypic and phenotypic correlation was estimated between plant height and biological yield. Plant height was negatively correlated with harvest index and grain yield, both at the genotypic and phenotypic levels. It was, however, non-significant at both levels. Significant and positive genotypic correlations were observed between biological yield with harvest index and grain yield. Path analysis showed that days to heading, days to maturity, and plant height had negative direct effect on grain yield, whereas biological yield and harvest index had a high and positive direct effect on grain yield. It may be concluded from the present studies that biological yield and harvest index may be considered as the best selection criteria in the selection of high yielding genotypes, at least from the standpoint of the evaluated set of genotypes.

Keywords: genotypic correlation, phenotypic correlation, bread wheat, path analysis, micro-plot trial, *Triticum aestivum*

Introduction

The yielding ability of a genotype is the result of the relationship among the yield contributing components (Gupta *et al.*, 1999). These yield components are interdependent in expression. Correlation analysis indicates the degree of association between traits. It cannot, however, provide the reasons of association. Therefore, simple correlation coefficients are not always effective in determining the real relationship among traits. Even though correlation analysis can quantify the degree of association between two characters, a significant correlation merely indicates the degree of association between the two characters. The method of path coefficient analysis provides effective means of determining the direct and indirect causes of association. A path coefficient is a standardized partial regression coefficient. As such, it measures the direct influence of one trait upon another and permits the separation of correlation coefficient into components of direct and indirect effects (Dewey and Lu, 1959).

The 1000-grain weight, in modern high grain number cultivars, has reduced slightly (Waddington *et al.*, 1986). The major factor of low yield of varieties, in the era before the green-revolution, was their tallness that is negatively correlated with yield (Hatam and Akbar, 1995). It was earlier found that correlations of days to heading with harvest index, 1000-grain weight with harvest index, and yield with harvest index were positive and significant (Ihsanullah and Mohammaed, 2001). Thus, the lines with medium height and higher harvest index would have potential for higher grain yield. Plant height showed a strong negative genotypic correlation with grain yield (Shahid *et al.*, 2002). Path analysis identified that 1000-grain weight and days to maturity had the positive direct effect on grain yield, whereas days to heading and plant height had negative direct influence on the grain yield (Pawar *et al.*, 1990).

In the common wheat, long vegetative period partly contributed to higher grain yield (Bingham, 1969). Positive correlation was observed between length of grain filling period and grain yield in the spring wheat (Spiertz *et al.*, 1971). Donald and Hamblin (1976) reported that the harvest index could be considered as a breeding criteria in cereals. To improve grain yield, selection in the F2 population should be for plants having high harvest index and high biological yield (Chowdhry *et al.*, 2000; Hakam *et al.*, 1997), since all these characters are correlated with grain yield. Correlation studies between seed yield and nine components in the durum wheat genotypes were carried out (Belay *et al.*, 1993), and it was found that seed yield exhibited a strong positive association with all the characters studied, except days to heading and harvest index. Besides the seed yield itself, plant height and 1000-grain weight may be considered good indirect selection criteria. Duration of vegetative period has a positive influence on grain yield and negative influence on grain filling period (Razzaq *et al.*, 1986). Cultivars with the
Isolation, Determination and Characterization of Taro (Colocasia esculenta) Starch

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Abstract. The starch content of taro (Colocasia esculenta) was determined using DNS colourimetric, acid-hydrolysis and enzymatic methods. Starch content varied from 80.3 to 81.3% as determined by DNS colourimetry. For the extraction of taro starch, different techniques were used. It was found that there was a noticeable improvement in the yield of starch using the freeze-thaw method. The various physicochemical properties of the extracted starch were also compared with the starch obtained by ammonia and alkali extractions. It was found that the hydration capacity, swelling volume, moisture absorption, freeze-thaw stability, as well as swelling power, were generally higher while solubility was lower of the freeze-thaw extracted starch than that extracted by ammonia and alkali. The DNS colourimetric method is recommended as a simple method for the determination of taro starch.

Keywords: taro starch, freeze-thaw extraction, starch extraction, DNS colourimetry, Colocasia esculenta, starch characterization

Introduction

Edible aroids are starchy tuber crops of the humid tropical and subtropical regions of the world. They are herbaceous plants (Family: Araceae), consisting of five genera of which Colocasia esculenta is the most important food crop. This species is commonly known as taro or old cocoyam, (vernacular: arvi, dasheen). It is an important low-cost starchy food source (Hong and Nip, 1990). Taro has been reported to have 70-80% starch on a dry weight basis (Jane et al., 1992; Tu et al., 1979), comprised of small granules, having dia between 1.4 and 5 μm (Sugimoto et al., 1986). Taro starch, in view of its small granule size, has been considered to be easily digestible, hence it is widely used in baby foods and the diets of people allergic to cereals and children sensitive to milk (Wang, 1983). In addition to the food use, taro has found some industrial applications as well. The small size of taro starch granules makes them ideal in cosmetic formulations, such as face powder, and in dusting preparations which use aerosol dispensing systems (Griffin and Wang, 1983). Taro starch has been considered to be a suitable filler in biodegradable plastics and as a fat substitute (Daniel and Whistler, 1990).

The starch content of edible aroids has been determined using a variety of analytical techniques. Average starch value of 679 g/kg, on a dry weight basis, was determined from cornels (Colocasia esculenta) grown in Bangladesh, by hydrolysis of starch (Chowdhury and Hussain, 1979). Using the glucoamylase hydrolysis and copper reduction method, the starch content of a single taro cultivar was reported to be 540 g/kg on a dry weight basis (Hussain et al., 1984). In another study, the starch content was calculated to be 70.6%, on a dry weight basis (Agbor-Egbe and Rickard, 1990). Starch values in this study were determined using acid hydrolysis and the ferricyanide reduction method. Since in the selection of edible aroid cultivars in a germplasm collection, the starch content is considered to be a very important characteristic, there is a need for the development of an accurate but simple and inexpensive method of starch analysis.

In spite of the versatile uses of the taro starch, large-scale extraction and utilization of taro starch is not practiced anywhere. This has been probably due to the difficulty in extracting the taro starch from fresh tubers, which also contain a lot of mucilaginous materials. Moorthy (1991) made an attempt to extract taro starch by using dilute solution of ammonia. In another study, the starch was extracted by using NaOH solution (Jane et al., 1992). The quality, as well as yield of the starch, using these methods, was found to be reduced due to the chemical treatments involved. An easy and convenient method is, therefore, also needed to be developed for the extraction of taro starch to produce good quality starch with better yield. The purpose of the present study was to explore a new technique for the isolation and determination of taro starch and to compare the so developed method with the reported methods by evaluating the physicochemical properties of the extracted starch.

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