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Effect of Exposure to Moisture and Petrochemicals on Medium Voltage Cable Jackets

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Abstract. The 15 kV, cross-linked polyethylene (XLPE) insulated underground power cables, having polyethylene (PE) and polyvinyl chloride (PVC) jackets, were studied regarding the influence of moisture, chemicals and petroleum products. PE jackets were found to possess more suitable properties in harsh conditions and performed better than PVC jackets for use in electric power utilities, industry and other uses.

Keywords: petrochemicals, power cables, cable jackets

Introduction
Polymeric insulated power cables are extensively used in transmission and distribution networks around the globe. In Arabian Gulf Cooperation Council (GCC) countries, several manufacturers are producing low, medium and high voltage cables using cross-linked polyethylene (XLPE) insulation and a variety of materials which are mostly installed underground. Cable outer sheaths or jackets provide protection against mechanical damage, ingress of moisture and attacks by ionic species and chemicals etc., present in the sub-surface soil and the underground water. For low-voltage cable, moisture can cause a degradation of electrical properties, such as insulation resistance. In case of instrument/control cables operating at higher frequencies, as well as fiber-optic cables, moisture can cause an increase in the attenuation, resulting in a loss of signal strength, whereas in case of medium and high voltage cables, moisture can lead to insulation degradation due to the water treeing mechanism (Abdolall, 1987; Mashikian and Groeger, 1987; Silver and Lukac, 1984).

In many petrochemical plants and other industrial installations, cables must survive the very corrosive chemical environment. Chemical contamination of soils can also have an adverse effect on the materials used for cables. Oils and organics can swell and deteriorate insulating and jacketing materials, thereby affecting their electrical and physical properties. Inorganics and ions from the soil can migrate into the insulation, leading to poor electrical properties and acceleration of the water tree degradation mechanism. Neutral conductor can be corroded which can increase the electrical resistance. With spiral or helically applied shields, it can result in partial or complete loss of electrical conductivity of the shield (Barras et al., 1997; Graham and Szaniszlo, 1995; Gucwa, 1978).

Mechanical damage of sheath can expose the cable insulation to the environment resulting in rapid deterioration of its properties. Thus a cable sheath must provide resistance to damage before, during and after installation of the cable. Due to these reasons, important factor in achieving optimum cable performance is the careful selection of jacket material (Barras et al. 1997). Correlating the intended operating environment and installation conditions of the cable with the attributes of the jacket materials will help maximize its effectiveness.

Several types of cable jackets are currently being used. Polyethylene (PE) jackets are often applied on power cables by electrical utilities and other industrial users. In addition, jackets of polyvinyl chloride (PVC) or chlorinated polyethylene (CPE) are used for cables, as well. CPE compares favourably with PE jacketing compounds, in most of the critical performance parameters. Table 1 illustrates the impact of some chemicals on PE, PVC and CPE sheathing materials (Bayer et al., 1995). Cable jackets in Arabian Gulf region are laid in a geographical terrain where the solar radiation is one of the highest. The subsoil surface elsewhere is marred with high content of chlorides and sulphates while the industrial areas are contaminated with spillovers of hydrocarbon fuels and chemical species. Cable jackets act as the first defense against the impact and permeation of these degradation parameters. Therefore, it is important to study the effects of chemicals and petroleum products on the performance of PE and PVC jackets.

In this research work, medium voltage cables having PE and PVC jackets were buried in soil and exposed to chemicals (NaCl and CuSO₄) and petroleum products such as petrol and...
Beneficiation Studies of Bajaur Manganese Ore by Different Processing Techniques

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Abstract. The manganese ore of Bajaur Agency of Pakistan was subjected to flotation, heavy medium separation, gravity concentration and magnetic separation techniques for beneficiation. The original composition of the manganese ore was 45.56% Mn, 4% Fe₂O₃, 40% SiO₂. The Mn content was raised to a maximum ~ 48.76% in the concentrate with the recovery of ~ 67.78% through flotation technique. Other techniques rendered marginal increase in Mn concentration against the theoretical possibility of substantial enrichment by rejecting the ~ 20% gangue minerals. The separation of manganese minerals from associated gangue was difficult, due to mineralogical complexity of the ore, extreme fineness of the particle size, texture and minerals intergrowth. High Mn/Fe ratio, phosphorus, and silica contents were within tolerable limits for utilisation of the ore in ferro-manganese production.

Keywords: manganese, Bajaur agency, magnetic separation, flotation, beneficiation

Introduction

Manganese, a grey metal resembling iron, is hard and brittle and of little use alone. It constitutes about 0.1% of the earth crust and is the twelfth most abundant element (JCPDS, 1979; Fraser and Belcher, 1975; Kostov, 1968; Palache et al., 1944). Manganese is essential for the steel industry where it is used mostly as a ferroalloy. Chief minerals of manganese are pyrulosite, romanechite, manganite, hausmannite and rhodochrosite (Rao et al., 1998; Craig and Vaughan, 1994; Roberts et al., 1990; Jacoby, 1975). Pyrulosite is a black, opaque mineral with a metallic luster and is commonly soft enough to soil the fingers. It is usually a secondary mineral formed by the oxidation of other manganese minerals. Romanechite, formerly known as pisolomelane (Brandes and Flint, 1980) is a hard, black amorphous material with a dull luster and is commonly found in massive form. When free of other oxide minerals, romanechite can be identified readily by its superior hardness and lack of crystallinity. Manganite is an opaque mineral of medium hardness, ranging in colour from steel grey to iron black, with a dark, reddish brown streak. It has also a sub metallic luster. Hausmannite is a black opaque mineral, usually crystalline having a sub metallic luster and specific gravity of 4.73 to 4.86. It has a hardness of 5.5 and a brownish black streak. Rhodochrosite is the most common carbonate mineral of manganese and usually occurs with rhodonite. It is light rose in colour, although other shades are not uncommon.

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None of the natural sulphides of manganese are of any commercial importance. Some silicates have been mined. Rhodnite and braunite are of interest because these are frequently associated with the oxides and carbonate minerals (Schouten, 1962).

In general, only the ores containing at least 35% manganese are classified as manganese ores. Those having 10-35% manganese are known as ferruginous manganese ores, and ores containing 5-10% manganese are known as manganiferrous ores (Kirk Othmer, 2004). Ores containing less than 5% manganese with the balance of mostly iron are classified as iron ores.

Pakistan, during 1989-90, imported manganese ore and concentrate, manganese dioxide, ferromanganese and manganese metal and articles, worth Rs. 293,486 thousand (Ahmed and Siddiqui, 1993). All of the ferromanganese is consumed by iron and steel industries. Most of the oxides, whether ores or others, are probably used in the manufacture of dry cells, with the remainder for other uses.

Different workers like (Master, 1960; Master and Qureshi, 1958; Rizvi, 1951) have described in detail some manganese deposits of Las Bela District in southern Balochistan. Las Bela deposits include those of Siro, Khabri, Dhora, Haji Mohammad Khan Bent and Kohan Jhal. In Khyber Pakhtunkhwa province, manganese deposits are located in Galdanian, Tarnawai, Abbottabad, and Chura Gali, about 19 km northeast of Abbottabad; a small lode manganese oxide
Mineralogical and Textural Characteristics of Kakul (Hazara) Phosphate Rock, NWFP, Pakistan

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Abstract. Various types of minerals, present in phosphate rock of Hazara area of Khyber Pakhtoonkhwa Province of Pakistan, were identified and their concentration was determined using a suitable method. The characteristics of the rock were defined by petrography, X-ray diffraction, and chemical analysis and the textural characteristics such as grain size, grain shape and their arrangement in the rock body were also investigated. The degree of liberation of phosphate-bearing mineral was studied by the particle-counting method. Mineralogical and textural observations indicated that fine-grained rock may be suitable for beneficiation by the froth flotation separation technique.

Keywords: phosphate rock, mineralogy, mineral beneficiation, Hazara, Pakistan

Introduction

Phosphorous is an essential constituent of plant and animal tissues. Phosphate esters of nucleotides are of immense biological importance and play an important role in energy-related-functions of living systems. All living organisms fulfill their phosphorous need from soil directly as well as indirectly. The main source of phosphorous in soil is phosphate-bearing minerals which occur in small amounts in nearly all igneous and sedimentary rocks. There are about 200 minerals found that contain more than 1% P2O5. The most important phosphate mineral in igneous rocks is fluorapatite, while in sedimentary rocks, it is carbonate fluorapatite (Zanin, 2004).

Some phosphate-rock deposits are high-grade and are suitable for direct feed to fertilizer plants without beneficiation. However, most phosphate rocks are low-grade and are always subjected to beneficiation processes such as washing, screening, heavy media separation, gravity concentration, froth flotation and calcination and are later dried to reduce the moisture content to 3-4%. Phosphate rock or concentrate is graded according to its P2O5 content as furnace grade (16-24% P2O5), fertilizer grade (25-31% P2O5) and acid grade (>31% P2O5). The major use of phosphate rock (90-95%) is in the manufacture of phosphate fertilizers, while the rest is used in the preparation of phosphoric acid, elemental phosphorous, and other industrial phosphate chemicals (Ozer et al., 2003). Phosphate-rock deposits of economic importance are both igneous and sedimentary in nature. Important igneous deposits, containing apatite, are often found in alkaline rock complexes. Apatite also occurs in magmatic carbonatites (calcite, siderite, dolomite and ankerite). The sedimentary phosphate deposits (phosphorites) are of two types, namely guano and pelletal. Guano deposits are formed from the accumulation of animal excrement of large sea birds, but they constitute only a small percentage of total production. Pelletal phosphorites are the largest deposits, furnishing over 80% of the world phosphate rock requirement. They are marine in origin and are commonly associated with dolostone or limestone (Van Kauwenbergh, 2003).

Phosphate deposits have been reported to exist at various localities in Pakistan, but the significant deposits occur in Hazara Division, in an area of about 100 km² in the north-east of Abbottabad city. The most promising and prospecting locations are Kakul, Sherwan (Barkot) and Sirban Hill (Havellian), Lagarban, Kalu-di-Bandi and Dalola village (Garhi Habibullah). The average reserves of these areas have been estimated to be around 18 million tons (Ahmad and Siddiqui, 1992).

Phosphorite deposits of the Kakul area, Hazara Division are located within latitude of 34°12' to 34°15'N and longitude of 73°16' to 73°30' E (Fig. 1). These are early Cambrian sediments having 516 m strike length with an average thickness of 4.5 m. There are two main types; the uppermost cherty dolomite of Abbotabad formation and lowermost silty calcareous phosphorites of Hazara formation. The main phosphatic horizon is found in cherty dolomite of Abbotabad formation. Phosphorites developed in this area are usually...
Electronic Properties of Au/MgF$_2$/Au Structures at Different Temperatures

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Abstract. Investigations of some electronic properties of vacuum evaporated thin film Au/MgF$_2$/Au structures such as circuiting $I_c$ and emission $I_e$ currents versus the applied voltage, electron attenuation lengths MgF$_2$ layers and the role of the latter layers showed that these devices undergo an electroforming process leading to decrease in resistivity of several orders of magnitude along with a negative resistance region in their $I-V$ characteristics. High emission current densities are archived for low applied voltages with the cathodes at or near the room temperature. By decreasing the temperature, both $I_c$ and $I_e$ decreased and at low temperatures the negative resistance region disappears completely. High values of hot electron attenuation lengths in the insulator were obtained and the significance of these high values is described.

Keywords: thin films, cold cathodes, electroforming, Au/MgF$_2$/Al thin films

Introduction

Thin layers of insulators sandwiched between two metal electrodes exhibit a number of interesting properties. If the insulating layer of a metal-insulator-metal (MIM) device is relatively defect-free and sufficiently thin (< 50 Å), it will conduct due to quantum mechanical tunneling (Simmons, 1963a; Fisher and Giaver, 1961). Once the voltage across the device is sufficiently high so that the conduction band of the insulator at the negatively biased electrode-insulator interface is energetically below the Fermi level of the positively biased electrode then the $I-V$ characteristics obey Fowler-Nordheim characteristics:

$$I = 3.35 \times 10^{17} \left(\frac{V}{\phi_o}\right)^2 \left(\frac{A}{\phi_o}\right) \exp\left\{-\frac{0.69t}{\sqrt{\frac{\phi_o^2}{V}}}\right\},$$

where $I$ is the current in mA, $V$ is the voltage in V, $t$ is the thickness in Å, $A$ is the barrier area in m$^2$ and $\phi_o$ is the barrier height in eV (Simmons, 1963b).

The device is then said to be in the field emission regime. At higher insulator thickness, the electric field is not usually high enough for the tunnel current to be measurable and any one of a number of other conduction mechanisms dominate, e.g., Schottky emission (field assisted thermal injection of carriers into the insulator from the metal), Poole-Frenkel emission (field assisted thermal emission of carriers from traps inside the insulator) or space charge limited conduction (Kao and Hwang, 1981).

If the thickness of the insulating layer of a metal-insulator-metal (MIM) device is in the correct range (100-10000 Å) and the device is placed in a vacuum (< 10-4 mbar) at a high enough temperature (room temperature or above), it undergoes a process known as electroforming when a sufficiently high voltage (greater than the forming threshold voltage) is applied across it. Filaments are thought to be created between the metal electrodes which bridge the insulating gap, and the device is said to be electroformed (or simply formed) (Sharpe and Palmer, 1996). This process can lead to the emission of energetic electrons from the device into the vacuum. Hence, when a bias voltage is applied across an unformed sample, an electroforming process takes place in the dielectric layer and its resistance is decreased. After electroforming, devices in which the dielectric is an oxide or oxide complex generally show a voltage-controlled negative resistance, electroluminescence, electron emission into a vacuum and a possible memory effect. The mechanism of electron transport through thin insulating films sandwiched between metal electrodes has been the subject of a number of theories to explain the current and voltage and related characteristics. One of the models which successfully explain thin layers of insulators sandwiched between two metal electrodes, has been put forward by Dearnaley et al. (1970). Their model explains the conduction of field induced metallic filaments in the dielectric matrix sandwiched between the two electrodes thereby providing low resistance paths for the current, and electron emission takes place from the ends of these filaments at the top positive electrode. To study the energy loss mechanism in these samples,
GC-MS Evaluation of Fatty Acid Profile and Lipid Bioactive of Partially Hydrogenated Cooking Oil Consumed in Pakistan

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Abstract. Evaluation of fatty acid profile including trans fat and lipid bioactive (tocopherol and sterol contents) of most commonly used vanaspati ghee and cooking oil brands was made by gas chromatography coupled with mass spectrometer detector (GC-MSD). Among the saturated fatty acids (SFA), palmitic and stearic acid were dominant fatty acids; the mean value of SFA in ghee and oil was 44.98 and 30.83%, respectively. Mean values of monounsaturated, polyunsaturated and trans fatty acids in ghee were 47.51, 7.49 and 8.08%, and in oil 49.26, 19.90 and 0.91%, respectively. α-Tocopherol was the major tocopherol while campesterol, stigmasterol and sitosterol were main phytosterols in terms of their quantity.

Keywords: GC-MSD, fatty acid profile, tocopherols, phytosterols, edible fats and oils

Introduction

Vegetable oils, made up of lipids, are very common commodities in our daily life (Mikuma and Kaneko, 2010). Some vegetable oils such as olive oil or roasted sesame oil are accepted as health beneficial foods and consumer demand for these oils is increasing. Depending on the production cost and availability of plant sources, the price of some vegetable oil is changing and blended oils can be found in some markets (Park et al., 2010).

Fatty acids (FA) in food and biological samples were commonly analysed by gas chromatography (GC), for long (James and Martin, 1952). Characterization and determination of various kinds of saturated, mono and polyunsaturated fatty acids together with their positional and geometrical isomers have been studied using GC-FID and GC-MS methods in different samples (Bail et al., 2009; Tokusoglu, 2008; Brondz, 2002; Ackman, 2002; Evershed, 1996; Eder, 1995). Hyphenation of the chromatographic technique with mass spectrometry provides a selective tool for the study of FA structures. FA play important roles in biological tissues and as constituents of lipids in biological membranes influence fluidity, integrity and activities of membrane-bound enzymes. Consumption of trans fat may increase the risk of coronary heart disease (Vijver et al., 2000; Ascherio et al., 1999; Hu et al., 1997). Oils and fats have been consistently associated in both epidemiological studies and clinical feeding trials with reduced blood cholesterol levels and decreased incidence of cardiovascular disease (Li et al., 2007; Ostlund, 2004; Elaine and Feldman, 2002). Intake of certain fats, such as saturated fats and hydrogenated oils (vanaspati), raises the cholesterol level; alternatively vegetable oils known as poly-unsaturated fatty acids may lower the cholesterol level. This is also achieved through intake of monounsaturated fats like olive oil (Sharma, 2000).

Important part of unsaponifiable matter of fats and oils comprises of sterols (Lagarda et al., 2006; Cunha et al., 2006; Apparich and Ulberth, 2004). The qualitative analysis of sterols is very helpful when adulteration is suspected (Lognay et al., 1993). Plant sterols are called phytosterols, which resemble cholesterol in function and structure (Kritchovsky and Chen, 2005). Many types of phytosterols have been reported in plant species, the more abundant ones being sitosterol, stigmasterol and campesterol (Berger et al., 2004; Moreau et al., 2002), and are predominantly found in plants (Grunwald, 1975). These are present mainly in nuts, vegetable oils, seeds, cereals and beans (Mitei et al., 2009; De Jong et al., 2003, Phillips et al., 2002). Sterols in vegetable oils occur mainly as free sterols and esters of fatty acids. Qualitative and quantitative analysis of sterols is often used for identifying lipid mixtures when adulteration is suspected.

The present study was undertaken to evaluate the quality of vanaspati ghee and cooking oil in terms of their fatty acid profile with special reference to trans fat and important lipid bioactives.

Materials and Methods

Samples and reagents. Samples of vanaspati ghee and cooking oils were purchased from local supermarkets of Hyderabad, Pakistan. The choice of the brands was based on
Introduction

Pollution due to heavy metals is now a worldwide phenomenon, these metals are discharged into the environment through industrial activity. In industrial areas, vehicular emission is the greatest source of atmospheric pollution contributing about 60% of the total load. Pollutants discharged from automobiles are CO, SO$_2$, NO$_x$, particulate matter and hydrocarbons. Many heavy metals including lead, cadmium, copper, manganese, nickel and zinc are also discharged into the atmosphere through the automobile exhaust.

Metals such as Fe, Cu, Zn and Cd are essential components of many alloys, wires and many industrial processes and may be released into the environment as a result of mechanical abrasion and normal wear (Jaradat and Momani, 1999).

Heavy metal analysis is important part of environmental pollution studies (Buszewski et al., 2000; Chibowski 2000; Momani et al., 2000). Determination of heavy metal contents in various environmental materials such as soil, natural water, plants, dust etc have been continuously performed by researchers (Krolak, 2000; Soylak et al., 2000).

Modernization and enhanced industrial activities have led to increase the use of fossil fuels and their derivates, particularly in metropolitan cities. Karachi is one of the thickly populated cities of the world with the population of more than 14 million, spread over 3580 km$^2$. It is congested with a large number of motor vehicles, including both public and private transport. It has also a well defined industrial base; there are about 20,000 small and large industrial units working in various industrial areas of Karachi city. Vehicular emission, biomass burning for cooking, brick kilns and industrial emissions around the Karachi city are the main contributor to heavy metal pollution.

Dust fall is an indicator of heavy metal pollution in the atmosphere and is a major means of ingress of heavy metals into the soil and subsequently living tissues of plants and human beings. A range of metals and chemical compounds found in the atmospheric dust environment results in health hazards. Pollutants can attack specific sites or organs of the body and disease can develop as a consequence of such exposure (Shinggu et al., 2007). Several epidemiological studies have indicated a strong association between elevated concentrations of inhaleable particles and increased mortality and morbidity (Mahmud et al., 2008).

The aim of this study was to investigate the present status of airborne heavy metal concentration of iron, zinc, lead, manganese, copper and cadmium in the environment of different industrial sites of Karachi city, so as to create a database that could help to develop future control strategies towards creating a pollution-free environment in Karachi.

Materials and Methods

Sampling map. Seventeen (17) locations were selected in three different industrial areas of Karachi metropolis along major roads, side roads and round-about as shown in the location map (Fig. 1).

Sampling. Dust samples were collected by deposited gauge method (Sami et al., 2006). Deposited gauge units were setup

Abstract. The study of accumulation of heavy metals, Fe, Cu, Mn, Zn, Pb and Cd, in the dust fall samples, collected from three selected industrial areas of Karachi, showed the level of heavy metals to decrease gradually from sites of high activity to those of low activity such as from roundabouts to main roads to side roads. Concentration of heavy metal showed a variation of the order Fe>Zn>Pb>Mn>Cu>Cd. Iron had the highest concentration in all the sampling areas in the range of $1.947 \pm 0.00$ to $30.039 \pm 0.01$ mg/g. Lower values were observed for Cd with respective ranges of $0.001 \pm 0.00$ to $0.009 \pm 0.01$ mg/g. The results suggested that heavy metal pollution in the dust fall samples of industrial areas may be due to automobile and industrial exhaust from different industrial units.

Keywords: dust fall, heavy metals, industrial areas, automobile emission, industrial emission, air pollution

Estimation of Heavy Metals in Dust Fall Samples from Three Different Industrial Areas of Karachi

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(received July 22, 2009; revised July 7, 2010; accepted July 21, 2010)
Nutritional Value and Antioxidant Activity of Various Extracts and Fractions of *Punica granatum* (Pomegranate) Peel

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**Abstract.** Evaluation of the nutritional value and antioxidant activity of *Punica granatum* peel extracts for their radical scavenging activity revealed that potent antioxidant activity, in the order of ethyl acetate fraction > chloroform fraction > petroleum ether fraction > water fraction. Ethyl acetate fraction had higher radical scavenging activity in comparison to a standard antioxidant like BHT.

**Keywords:** *Punica granatum*, nutritional profile, DPPH, reducing power activity, antioxidant activity

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**Introduction**

*Punica granatum* (pomegranate) belongs to the family Punicaceae and has been used in a number of natural medicines since time immemorial (Murthy *et al.*, 2004; 2002). It is widely cultivated throughout India, Pakistan, South East Asia and East Indies.

The fruits improve heart health, give protection against prostate cancer and slow down the cartilage loss in arthritis. The dried rind of *P. granatum* fruit is used in the treatment of amoebic dysentery, diarrhoea, low appetite, hyper-acidity, hemorrhages and tapeworm infestation (Nadkarni, 1982). Pomegranate peel is the major source of polyphenol (flavonoids, anthocyanin, proanthocyanidins) and tannins (Jaiswal *et al.*, 2010; Guo *et al.*, 2003) showing antiinflammatory, antibacterial, anticancer and antioxidant activities (Lansky and Newman, 2007; Daniells, 2006; Li *et al.*, 2006; Prashanth *et al.*, 2001).

It is well known that reactive oxygen species (ROS) formed in vivo, such as superoxide, hydrogen peroxide, hydroxyl radical and singlet oxygen are implicated in degenerative diseases such as cancer, inflammation, atherosclerosis and aging as also in food deterioration. In foods, rancidity is caused by formation of free radicals that lead to development of off-flavours and undesirable chemical compounds (Chatterjee *et al.*, 2007). Antioxidants are phytochemicals, vitamins and other nutrients that protect our cells from damage caused by free radicals. Artificial antioxidants like butylated hydroxyanisole (BHA) and butylated hydroxytoluene (BHT) which are often used in food industry, are suspected to be toxic and carcinogenic. Hence, the importance of research for finding naturally occurring antioxidants has been greatly increased in the recent years (Nadaroglu *et al.*, 2007).

The aim of the present study was to evaluate the nutritional profile and antioxidant activity of various fractions of *H₂O, methanol, ethanol* extracts of *P. granatum* peels.

**Materials and Methods**

**Collection of plant material.** *P. granatum* fruit was purchased from local market and peels were removed from the fruit manually. Peels were dried at 60 °C for 36 h and ground into powder.

**Reagents and solvents.** 2,2'-diphenylpicrylhydrazyl (DPPH) (Sigma Co, USA), BHT (Merck), hexane, methanol, ethanol, petroleum ether, chloroform, ethyl acetate (Merck) and distilled water etc., were used.

**Nutritional profile evaluation.** Nutritional profile was evaluated according to the standard AOAC methods (AOAC, 2005).

**Extraction procedure.** Three extracts of peels were obtained using solvents: water, methanol and ethanol. Completely dried powdered peels (100 g) were extracted with 500 mL of water at 80-90 °C for about 7-8 h. Similar process was repeated with methanol and ethanol at 60 °C for 7-8 h. Procedure was repeated thrice with each solvent. The extracts were oven dried and their percentage yield was calculated. These extracts were dissolved in distilled water and partitioned sequentially with solvents such as petroleum ether, chloroform and ethyl acetate. These fractions were subjected to tests for free radical scavenging and reducing power activity.

**DPPH free radical-scavenging assay.** The free radical-scavenging activity of Pomegranate peel fractions on the DPPH radical was assessed using the method described by...
Biophysicochemical Variability Evaluation of *Jatropha curcas* L. Collections for Biodiesel Feedstock

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\textbf{Abstract.} The seed oils of six *Jatropha curcas* biotypes were evaluated for their oil quality parameters and showed: oil content (38-41 %), acid value (0.14-6.94 mg/g), free fatty acid (0.07-3.47 %), iodine value (115.48-163.37 mg/g) and viscosity (0.6320-0.7431). Significant differences among biotypes were observed in oil yield and biochemical parameters. The variability among the biotypes indicate a good scope of genetic gain through selection.

\textbf{Keywords:} *Jatropha curcas*, biodiesel, chemical composition, seed oil

\section*{Introduction}

In anticipation of the supposed alarming scarcity in the production of crude petroleum oil and at the same time an increase in the number of automobiles and other internal combustion engines, the use of biodiesel with the diesel and alcohol in petrol has been made mandatory to initially minimize the cost of import. *Jatropha curcas* is a challenge species that can reduce the load of diesel import into the country. Genus *Jatropha* belongs to the family Euphorbiaceae and contains approximately 175 succulents, shrubs and trees; some are deciduous like *Jatropha curcas* L. having different uses. Its fruits and seeds are used as combustibles, fodder and green manure, seed oil is used as fuel, in production of soaps and for medicinal purpose, whereas the whole plant is put to a number of purposes.

Performance of engine associated problems have been encountered due to several basic properties of vegetable oils, used as biofuel such as naturally occurring gums, high viscosity, acid composition, free fatty acid content and low cetane rating. Therefore, it is crucial to estimate those parameters before using vegetable oil or biodiesel as a fuel substitute. The present study envisages use of *Jatropha* as a fuel plant, wherein different *Jatropha* biotypes grown at different geographical locations with respect to their biophysicochemical parameters, have been compared.

\section*{Materials and Methods}

Six biotypes of *J. curcas* were collected from different geographic locations of India (Table 1). Seed samples were kept in the oven at 70 °C for 5-6 h for removal of moisture. Then, seeds were grinded finely for extraction of oil. Conventional soxhlet technique was used to estimate oil content according to AOAC (1984). Then, the following physicochemical parameters were estimated according to Harris (1984).

\textbf{Specific gravity.} Specific gravity of the oil was determined using specific gravity bottle which was first weighed empty (\(W_b\)) then filled completely with the liquid and weighed (\(W_l\)). After cleaning, the bottle was filled completely with distilled water and again weighed (\(W_w\)). The temperature of the liquid was also recorded.

\begin{equation*}
\text{Specific gravity} = \frac{W_l - W_b}{W_w - W_b}
\end{equation*}

\textbf{Refractive index.} Refractometer was cleaned with alcohol and ether. A drop of oil was placed on the prism. The prism was closed by the ground glass-half of the instrument. The dispersion screw was adjusted so that no colour line appeared between the dark and illuminated halves. The dark line was adjusted exactly on the wires and the refractive index was read on the scale.

\textbf{Acid value.} Acid value was determined according to AOCS (1988). About 0.1 g of oil was weighed accurately in a 250 mL conical flask, dissolved in 50 mL of neutralized isopropanol followed by addition of 1 mL phenolphthalein solution. The solution was titrated with N/10 KOH with constant shaking until a pink colour persists for 15 sec. The titre value in mL (\(a\)) was recorded.

*Author for correspondence; E-mail: kcbiochem@rediffmail.com*
Screening of Selected Medicinal Plants for the Antioxidant Potential

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According to the World Health Organization, approximately 75-80% of the world population use plant-based medicines (WHO, 2007; 2003). Pakistan has a great wealth of medicinal plants worth a lot for the country. These plants are locally used by the herbal practitioners for treatment of various ailments and consumed by the public. Unfortunately, very little work is reported regarding the exploration of antioxidant potential of medicinal plants, especially in Pakistan.

Antioxidants are free radical scavengers such as glutathione peroxidase, catalase, superoxide-dismutase, present in lower concentrations than biomolecules and may prevent, protect or reduce the oxidative damage and defend the body against a number of diseases. (Adetuyi and Ogundahunsi, 2010; Hussain et al., 2009; 2008a; Khan et al., 2008; 2006; Odukoya et al., 2002; Oke and Hamburger, 2002).

In previous studies, the medicinal plants of Pakistan were explored for phytochemicals and heavy metal contents along with phytomedicinal, agrochemical and allelopathic potentials (Hussain and Khan, 2010; Hussain et al., 2009; 2008a; 2008b; 2006a; 2006b; Khan et al., 2009a; 2009b; 2008; 2007; 2006; 2005). In the present work, efforts have been made to investigate prominent medicinal plants of Pakistan for the antioxidant potential.

Table 1 shows the botanical names and families of selected medicinal plants along with the results of antioxidant assay. The plants were shade dried, powdered, extracted with MeOH and aluminum coated thin layer chromatographic plate of each extract was developed. The developed spots were viewed in the UV-light at 365 and 254 nm; the efflorescent points were marked, sprayed with 2,2-diphenyl picryl hydrazyl (DPPH) reagent and the colour produced on the plate was noted (Oke and Hamburger, 2002; Odukoya et al., 2002; Wagner and Bladt, 1996). DPPH reagent, is specifically used for the detection of polyphenolic compounds through forming complexes with the free hydroxyl group present in the crude extract (Khan et al., 2008; 2006; Oke and Hamburger, 2002; Odukoya et al., 2002). Wagner and Bladt (1996) reported causal relationship between antioxidants activity, medicinal plants, DPPH radical assay, Pakistan.

Table 1. Antioxidant potentials of the selected medicinal plants

<table>
<thead>
<tr>
<th>Medicinal plants</th>
<th>Family</th>
<th>Antioxidant assay</th>
<th>Colour of efflorescent spots</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hyoscyamus niger</td>
<td>Solanaceae</td>
<td>++</td>
<td>Blush</td>
</tr>
<tr>
<td>Carthamus lanatus</td>
<td>Asteraceae</td>
<td>+ +</td>
<td>Yellow</td>
</tr>
<tr>
<td>Foeniculum vulgare</td>
<td>Apiaceae</td>
<td>+ +</td>
<td>Blue</td>
</tr>
<tr>
<td>Citrullus colocynthis</td>
<td>Compositae</td>
<td></td>
<td>Blue</td>
</tr>
<tr>
<td>Cissampelos pareira</td>
<td>Compositae</td>
<td>- -</td>
<td></td>
</tr>
<tr>
<td>Hypericum dyeri</td>
<td>Hypericaceae</td>
<td>+ +</td>
<td>Deep purple</td>
</tr>
<tr>
<td>Hypericum perforatum</td>
<td>Hypericaceae</td>
<td>+ +</td>
<td>Blush</td>
</tr>
<tr>
<td>Equisetum arvense L</td>
<td>Equisetaceae</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cichorium intybus</td>
<td>Asteraceae</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Momordica charantia</td>
<td>Cucurbitaceae</td>
<td>+</td>
<td>Blush</td>
</tr>
<tr>
<td>Solanum xanthocarpum</td>
<td>Solanaceae</td>
<td>+ +</td>
<td>Blush</td>
</tr>
<tr>
<td>Galium aparine</td>
<td>Rubiaceae</td>
<td>+</td>
<td>Blue</td>
</tr>
<tr>
<td>Xanthium strumarium</td>
<td>Compositae</td>
<td>+ +</td>
<td>Yellow</td>
</tr>
<tr>
<td>Ammi visnaga</td>
<td>Umbelliferae</td>
<td>+</td>
<td>Deep bluish</td>
</tr>
<tr>
<td>Euphorbia helioscopia</td>
<td>Euphorbiaceae</td>
<td>+ +</td>
<td>Blush</td>
</tr>
</tbody>
</table>

* = no antioxidant activity; + = low antioxidant activity; ++ = moderate antioxidant activity; +++ = significant antioxidant activity.

Abstract. Screening of selected prominent medicinal plants of Pakistan, used by local herbal practitioners for treatment of various ailments, namely Hyoscyamus niger, Carthamus lanatus, Foeniculum vulgare, Citrullus colocynthis, Cissampelos pareira, Hypericum dyeri, Hypericum perforatum, Equisetum arvense L., Cichorium intybus, Momordica charantia, Solanum xanthocarpum, Galium aparine, Xanthium strumarium, Ammi visnaga and Euphorbia helioscopia, using 2,2-diphenyl picryl hydrazyl (DPPH) radical assay was undertaken. C. pareira, E. arvense L. and C. intybus were found to be devoid of antioxidant activity, while the rest displayed variable levels of antioxidant potential.

Keywords: antioxidant activity, medicinal plants, DPPH radical assay, Pakistan
The Effect of Drying and Salting on the Nutrient Composition and Organoleptic Properties of Vernonia amygdalina Leaves

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(Received February 17, 2010; revised June 22, 2010; accepted June 29, 2010)

Abstract. The preservation methods used for finding their effect on the nutrient content and organoleptic properties of Vernonia amygdalina leaves (bitter leaf), included oven drying at 40 °C without any pretreatment, blanching in steam prior to oven drying at 40 °C, light brining (25 g salt/L water), light dry salt treatment (25 g dry salt/kg leaves), light brine and vinegar treatment (50 g salt + 50 mL vinegar), and heavy salting (250 g/kg leaves), each for a duration of 14 days. Compared with drying alone, blanching before drying did not affect vitamin C, β-carotene, total carotene and ash content, but resulted in decrease of iron, sodium and calcium. Relative to the fresh vegetable, fermentation resulted in a decrease in the content of all the nutrients investigated except sodium and calcium which increased.

Keywords: Vernonia amygdalina leaves, steam blanching, drying, salting, nutrient composition

Introduction

Drying and fermentation are old and reliable food preservation methods. Pretreatment of leafy vegetables by blanching or scalding in hot water or steam makes the product tender, limits discolouration, eliminates intracellular gases responsible for oxidation reactions, kills harmful bacteria and deactivates enzymes which disintegrate the tissues (DiPersio et al., 2007; Kendall et al., 2004). Blanching and other thermal treatment of green leaves can also enhance the bioavailability of micronutrients by destroying antinutrients and by releasing the micronutrients entrapped in the plant matrix (Yang and Tson, 2006; Yadav and Sehgal, 2002). Thin-slicing facilitates better heat and chemical penetration, and water loss during drying, resulting in shorter drying time and better preservation of heat-labile nutrients.

Salting or brining of vegetables offers tremendous possibilities both for their commercial and home preservation. In the process, the salt exerts a selective action on the naturally occurring organisms to promote a desirable fermentation. Salt tolerant microorganisms use, as their nutritive material, the soluble constituents that diffuse out of the vegetable as a result of the action of the salt on vegetable tissue. These fermentative organisms bring about the production of various compounds, principally lactic acid but also acetic acid (both of which result in reduction of pH), alcohols and considerable amounts of gas. Production of sufficient amount of acid makes the medium unsuitable for the growth of food spoilage bacteria. In addition, acid and other microbial metabolites alter the flavour of the food. Substances and organisms in fermented foods can cause changes in the composition and/or activity of the gastrointestinal microbiota resulting in several health benefits (FAO, 2007; Perdigon et al., 1987).

Vernonia amygdalina, variously known as bitter leaf (English), oriwo (Edo), ewuro (Yoruba), shikawa (Hausa), and olubu (Igbo), is a tropical shrub, 1-3 m in height (Igile et al., 1995). The leaves are dark green with characteristic odour and bitter taste. The species is indigenous to tropical Africa, where it is found wild or cultivated. The leaves are eaten after crushing and washing thoroughly to remove the bitterness (Mayhew and Penny, 1988). As with other high yielding leafy vegetables, post-harvest losses may occur due to inadequate preservation.

In this study, three preservation techniques—drying without pretreatment, blanching in steam followed by drying, and salting—were employed for the preservation of Vernonia amygdalina leaves. The effects of the treatments on the nutrient composition and organoleptic characteristics of the vegetable were then investigated.

Materials and Methods

The leaves of Vernonia amygdalina were subjected to the following treatments:

Preparation and steam blanching of leaves. A known weight of thin slices of V. amygdalina leaves was wrapped in clean cheese cloth, tied with a string and put on the mesh in the water bath. Care was taken not to have the cloth immersed in water but deep enough to be engulfed by the steam. The lid of the water bath was replaced and the samples left to steam for 2 min.
A simple and precise spectrophotometric method has been developed using pH 6.8 phosphate buffer as a solvent; it can be considered a promising simple, faster, direct and relatively less expensive alternative with sufficient reliability for the determination of active drug content in pharmaceutical formulations, in bulk and in dosage forms.

Stavudine capsule, Avostav™ (30 mg stavudine), obtained as a gift from Ranbaxy Laboratories Ltd. (Paonta Sahib), was subjected to in vitro quality control tests like disintegration, weight variation and assay following the Indian pharmacopeial procedures, whereas stavudine (analysed sample), received on gratis from Cipla Ltd. (Mumbai, India), was used as such without further purification. All other chemicals used were of analytical grade. All the solutions for analysis were prepared and analyzed afresh.

A solution of Stavudine was prepared by dissolving 100 mg of standard Stavudine in 100 mL pH 6.8 phosphate buffer and suitably diluted to get a working standard solution of 60 μg/mL. Aliquots (0.5, 1, 1.5, 2, 2.5, 3, 3.5, 4 mL) of working standard solution were transferred to a series of 10 mL volumetric flasks to obtain final drug concentration of 3 to 24 μg/mL. Average weight of twenty capsules were determined, and then finely powdered. The powder (30 mg) was extracted with 100 mL pH 6.8 phosphate buffer for 45 min; the suspension was filtered using Whatman # 1 filter paper. 0.5 mL of this solution was diluted to 10 mL to obtain a concentration of 15 mg/mL of Stavudine (Borgmann et al., 2007). The absorbance of the solution was determined at 266 nm against a reagent blank.

The repeatability of the method was established by carrying out (n = 8) the analysis of analyte (15 mg/mL) using the proposed method (Gandhi et al., 2008).

The accuracy of the method was evaluated by calculating the recovery of stavudine by standard addition method at concentration of 80%, 100% and 120% of the target level in
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