



## Fixed Oil Composition, Polyphenols and Phospholipids of Finger Millet [*Eleusine coracana* (L.) Gaertn]

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(Received 2 April 2012 Accepted 20 April 2012)

**ABSTRACT** : Not much is known on the fixed oil composition, polyphenols, phospholipids of finger millet [Ragi-*Eleusine coracana* (L.) Gaertn], a tropical cereal crop of India and Africa. The oil content of this grain is found to be 0.74% consisting of oleic acid (47.17%), linoleic acid (24.78%) and palmitic acid (23.06%). The flavonol present was quercetin and cyanidin was the anthocyanidin present. Vanillic, syringic, ferulic and caffeic acids were the phenolic acids present. The total phenolics amounted to 3.2 mg/gm. The total antioxidant potential was  $I_{c50}$  10.6 + 0.03 mg/ml. in terms of ascorbic acid and gallotannin. The phospholipids present in Ragi was 0.36% consisting of lecithins, cephalins and galactolipids. The health benefits of all these compounds are highlighted.

**Keywords** : Finger millet, *Eleusine coracana*, quercetin, cyanidin, phospholipids, fixed oil, linoleic acid, oleic acid, palmitic acid, phenolic acids, antioxidant potential.

### INTRODUCTION

Ragi (*Eleusine coracana*) is an African genus and one of the important millets of the world. It is the principal staple food of many tribes in the dry-land regions of East Africa, Ethiopia, Somaliland and Southern India. In India, the area under Ragi cultivation covers 3–4 million hectares.

The nutritive value of Ragi is because of the carbohydrate content: 72%; proteins: 7.3%; fats: 1.4%; minerals: 2.7%. Ragi also has some good number of Essential Amino Acids (EAA) which are essential for human body. Few of the key EAAs which Ragi contains are Valine, Methionine, Isoleucine, Threonine and Tryptophan. Methionine is said to help promote growth of healthy skin and hair and is generally lacking in staple diet of hundreds of millions of people. The presence of about seven phenolic acids such as gallic acid (GA), tannic acid (TA), vanillic acid (VA), ferulic acid (FA), caffeic acid (CA), chlorogenic (Chl-A) acid and protocatechuic acid (P-Cat-A) (Singh *et al.*, 2008).

Though it is a major diet of many tribes, not much of the work has been undertaken on the other important constituents such as the oil content, flavonoids, phospholipids and the total antioxidant potential. Of late there is a resurgence of interest in these compounds as they are found to impart a number of health benefits to the consumer (Jones *et al.*, 2002; Dykes and Rooney, 2007). Research has shown that whole grain consumption helps lower the risk of cardiovascular disease, ischemic stroke, type II diabetes, metabolic syndrome, gastrointestinal cancers. In addition to dietary fibre, whole grain contains many health promoting components such as minerals, vitamins and phytochemicals, which include phenolic compounds.

Phenolic compounds have anti-oxidant properties and can protect against degenerative diseases (*i.e.* heart diseases and cancer) in which reactive oxygen species (*i.e.* superoxide anion, hydroxyl radicals and peroxy radicals) are involved (Rhodes and Price, 1997).

### MATERIALS AND METHODS

The seeds were obtained from Gujarat State Seeds Corporation, Vadodara. The powdered grain is extracted with petroleum ether and the total ether solubles quantified. The saponification value of the oil is estimated using standard methods. For GC-MS analysis, the Equipment used was Focus-PolQ GC/MS (Thermo); Column: ZB-5 capillary column (30 m × 0.25 mm × 0.25 mm); Oven temperature: 80°C for 5 min, then increased 3°C/min to 220°C and held for 5.0min.; Injector Temperature: 230°C, Carrier gas: Helium (1mL/min). The injection volume was 0.5ul and EI-MS: 70 eV in the range m/z 30–400. Individual compounds were identified as methyl ester by comparing their mass spectrum with library (NIST) and literature (Adams 2007).

The phospholipids and phenolics were extracted from defatted material using methanol in a Soxhlet's extractor. The methanol extract is concentrated and on addition of acetone to this concentrated extract phospholipids precipitated, which are filtered and quantified. The acetone solubles remaining after the separation of phospholipids contained phenolics including flavonoids.

Phospholipids were analyzed by TLC (Silica gel) using the solvent systems acetone: benzene: water (91 : 30 : 8,v/v) and chloroform: methanol: acetic acid: water (170 : 30 : 20 : 7,v/v/v/v). Lecithins were visualized by spraying the developed chromatograms by Dragendroff's reagent (to

locate choline-containing lipids) and the cephalins were located by Ninhydrin reagent. Galactolipids were identified by spraying the TLC plates with anisaldehyde-sulphuric acid reagent. Total phenols were estimated by Folin-Ciocalteu method (Singleton *et al.*, 1999). Flavonoids were analyzed by standard methods prescribed by Mabry and co-workers (1970). The identification of phenolic acids was done following Ibrahim and Towers (1960). The Total antioxidant activity was measured using the well-known DPPH method (Siddique *et al.* 2010).

## RESULTS

**1. Oil content.** The total oil content estimated from the petroleum ether extract of dry coarsely powdered sample is 0.74%. The Saponification value of this oil is found to be 199.1. GC analysis of oil showed the presence of total 14 peaks and the presence of about 13 fatty acids. The fatty acids present in major amounts are:

Sr. no.	Number of carbon atoms	Common name	Amount (%)
1.	16	Palmitic acid	23.06
2.	18:1	Oleic acid	47.17
3.	18:2	Linoleic acid	24.78

The fatty acids present in minor amounts are:

Sr. no.	Number of carbon atoms	Common name	Amount (%)
1.	18	Stearic acid	0.58
2.	18:3	Linolenic acid	2.26
3.	20	Arachidic acid	0.27

About 7 unknown fatty acids present in minor amounts have also been found to be present in the sample.

**2. Phospholipids.** Total phospholipids present in ragi is found to be 0.36%. There were five phospholipids of which two were cephalins and the rest of lecithins. There was a band of galactolipid also.

**3. Phenols.** The total phenols amounted to 3.2 mg/gm in terms of gallotannin. Flavonol, anthocyanidin and phenolics acids were the types of phenolics present. The flavonol located was quercetin. Cyanidin was found to be the anthocyanidin which contributed towards the brownish red colour of Ragi. The phenolic acids identified were vanillic acid, syringic acid, ferulic acid and caffeic acid. The total antioxidant potential was  $Ic_{50} 10.6 \pm 0.03$  mg/ml. in terms of ascorbic acid and gallotannin.

## DISCUSSION

Ragi oil is rich in unsaturated fatty acids of great importance. The comparatively high amounts linoleic acid (23%) which is an omega 6-fatty acid, is highly significant because this acid is easily converted to n-6 eicosanoids, n-6 prostaglandin and n-6 leucotriene hormones. This provides targets for drug development in atherosclerosis (B.P), asthma, arthritis, immunity development etc. Linoleic acid is also very popular in beauty products as helping in moisture retention, acne reduction, and anti-inflammatory. Lack of linoleic acid causes dry hair, hair loss, and wound healing. Therefore, the consumption this millet containing oil will yield the same advantages to the consumer. Oleic acid, which is an omega-9 fatty acid as the major fatty acid also is equally important having all the health benefits of linoleic acid. In cases of reduced availability of omega-6-fatty acids, omega-9-fatty acids are converted to omega-6-fatty acids.

The presence of good amounts of phospholipids consisting both lecithins and cephalins, also offer many advantages. Phospholipids of other cereals like rice, wheat, corn, etc. are not available to the consumer because they are removed dissolved in oils. These compounds are having great role in general metabolism, being concentrated in brain are useful in brain function, behavioral disorders and stress. They help in regeneration of membranes and protect liver, lungs, kidneys, and gastrointestinal tract. These compounds are known to enhance the bioavailability of other nutrients and medicines.

The presence of quercetin in ragi provides a number of health benefits to this millet. The flavonoids are known to have a positive role in strengthening the capillary walls, thinning blood by reducing the agglutination of RBCs and even preventing cancer. The anti-inflammatory properties of flavonoids also are well known. Quercetin, the flavonol present here, possesses many beneficial effects on human health including cardiovascular protection, anti-cancer activity, antiulcer effects, antiallergic activity, cataract prevention and antiviral and anti-inflammatory effects (Miller, 1996) and also inhibits lipid peroxidation in vitro (Chen *et al.*, 1990). Paired with ascorbic acid, quercetin reduced the incidence of oxidative damage to neurovasculature structures in skin and inhibited damage to neurons caused by experimental glutathione depletion (Skaper *et al.*, 1997). Anti-inflammatory activity quercetin appeared to be due to its antioxidant and inhibitory effects on the inflammation producing enzymes like cyclooxygenase and lipoxygenase and their subsequent inhibition of inflammatory mediators including leukotrienes and prostaglandins (Kim *et al.*, 1998). Quercetin exerted antiviral activity against reverse transcriptase of HIV and the other retroviruses and was shown to reduce the infectivity and cellular replication of the viruses like Herpes Simplex virus-type I, polio virus - type I, para influenza virus type III and respiratory syncytial

virus (Kaul *et al.*, 1985). Much of the recent research on quercetin has been shown it to be an anticarcinogen to numerous cancer cell types including breast, colon, endometrial, gastric, leukaemia, ovary and squamous cell (Larocca *et al.*, 1995; Pereira *et al.*, 1996; Caltagirone *et al.*, 1997).

Cyanidin, the anthocyanidin present also is known to have a number of beneficial effects. Anthocyanidins are well known antioxidants and they exhibit antitumour, antioedema, antiinflammatory and antiulcer activities. therefore, the consumption of ragi would entitle these benefits also to the consumer.

Phenolic acids are also known to possess profound curative properties. All the phenolic acids identified i.e., ferulic acid is (analgesic, antiallergic, anti-inflammatory, hepatoprotective and antihepatotoxic, immunostimulant, antiallergic, arteriodilator and acts against cancer in the colon, liver and skin), vanillic acid, (anthelmintic, anti-fatigue, anti-inflammatory, antileukemic, antiseptic and anti-sickling), syringic acid (antioxidant, anti-peroxidant and anti-radicular) and caffeic acid (anti-ageing, anti-histaminic, anti-allergic, anti-cancerous etc.) are known to have distinct pharmacological properties (Dukes database).

Both flavonoids and phenolic acids are known to be highly active antioxidants. The role of antioxidants in human diet is being increasingly felt these days. Since it is understood that all the chronic diseases like diabetes, cancer, stroke, atherosclerosis etc are caused by either by the reduced levels of antioxidants in the body or the increased levels of free radicals, "The Anti-oxidant Therapy" in which antioxidant supplements are given regularly are resorted to.

## ACKNOWLEDGEMENTS

The authors gratefully acknowledge the help rendered by Dr. S. Maiti, Director, DMAPR, Anand and Dr. V. Rana in getting the analysis of the fatty acids in the oil using GC-MS.

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