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Chemical Analysis of Nutritional and Anti-nutritional properties of Groundnut shell and its Waste Management

• **Priyanka** • **Arpita Anand** • **Pallavi Kumari**
• **Urvashi Sinha**

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Corresponding Author : Urvashi Sinha

Abstract : *The present investigation was aimed at assessing the chemical components present in the groundnut shell extract. Analysis of aqueous and ethanolic extract shows the presence of major nutritional components like protein, carbohydrate, lipid content etc and also anti nutritional components like oxalates, alkaloids, tannin and phenol. The ethanolic extract was also found to be effective against the gram-negative bacteria Escherichia coli. FTIR result shows the presence of tertiary amides and alkenyl like the functional group. The Result of the Atomic Absorption Spectrophotometer suggests that the concentrations of Copper and Zinc gradually reduced from 0.225µg/ml to0.125µg/ml and 0.0024µg/ml to0.010µg/ml respectively. Hence, the research work suggests groundnut shell waste as a potential bio- absorbent.*

Keywords: *Groundnut shell, Atomic Absorption Spectrophotometer, Escherichia coli, FTIR.*

Priyanka
B.Sc. III year, Botany (Hons.), Session: 2014-2017,
Patna Women's College, Patna University, Patna,
Bihar, India

Arpita Anand
B.Sc. III year, Botany (Hons.), Session: 2014-2017,
Patna Women's College, Patna University, Patna,
Bihar, India

Pallavi Kumari
B.Sc. III year, Botany (Hons.), Session: 2014-2017,
Patna Women's College, Patna University, Patna,
Bihar, India

Urvashi Sinha
Assistant Professor, Deptt. of Botany,
Patna Women's College, Bailey Road,
Patna–800 001, Bihar, India
E-mail : urvashi_vrm@yahoo.co.in

Introduction:

Arachis hypogaea, the peanut or groundnut, is an annual herbaceous plant in the Leguminosae family, originated and domesticated in South and Central America 3,500 years ago, and is now grown in tropical and warm-temperate regions worldwide for its seeds and their oil. The Legume family is one of the largest families of the plant kingdom that contributes agricultural wastes in the form of oilseed harvest residues. Peanut is the second most important legume in the world on the basis of total production after soyabean (Redden.,et.al. 2005). Being an oil seed crop, it liberates a tremendous amount of by-product, of which husks or shells of groundnut are considered as agricultural waste. Peanut shells, also known as peanut hulls, similar with peanut roots, are classified as low value agricultural wastes or agricultural by-products. In

early 1940, a new technology and innovation converted peanut hulls to a wide range of applications. Literature sources have reported the utilization of peanut shell as animal foodstuffs, such as, dogs, cattle and horses as peanut shells or peanut hulls were found to contain moderate level of protein (8%) as well as a high level of crude fiber and lignin. Peanut hulls are a bulky waste generated in large amounts. In peanut producing countries they are often burned, dumped, or left to deteriorate naturally (Singh.et.al.,1999). In the past decades, environmental concerns have led to an interest in using peanut shells for a variety of purposes; fuel mulch, carrier for chemical and fertilizers, bedding for livestock and poultry, pet litter, soil conditioners, etc (Hill 2002).

Material:

Shells of groundnut were collected from a local market in Patna. The shells were kept in Hot air oven at 70°-80°C for drying. Dried shells were powdered and then two extracts were prepared by dissolving shell powder in distilled water and ethanol dissolved in 10:1 (w/v) (Saklani et al 2011). The mixture was then centrifuged at 1048g (2500rpm and radius 15cm) rpm for 10 minutes. The filterate obtained was used as the final extract and was subjected to different phytochemical tests for nutritional and anti-nutritional, detection of functional group, anti-bacterial properties and for absorption of some heavy metals.

Methods:

Qualitative:

Phytochemical screening of the extract: The extract was subjected to the phytochemical screening which was done using the method adopted by S. Abdulrazak et al(2014) to test the presence of protein, carbohydrate, lipid content,oxalate. To test the presence of alkaloids, tannins and phenols, standard method of detection was followed.

Test for protein (Biuret test): One ml of aqueous sample was treated with an equal volume of 1% strong base and the few drops of aqueous copper(II) sulphate, and then change in colour was observed.

Test for Carbohydrate (Molisch's test): One ml of extract was taken and 2-3 drops of 1% alcoholic α-napthol solution along with 2ml of conc. Sulphuric acid was added, appearance of ring at the interference between acid and test layers was observed.

Test for Lipid content (Emulsion test): Sample was suspended in ethanol, allowing lipids to dissolve. The liquid was then decanted and cloudy white emulsion was observed

Test for Alkaloids (Mayer's test): One ml of extract was taken and treated with Mayer's reagent. Formation of cream precipitate indicated the presence of alkaloids.

Test for Tannin: One ml of plant extract was taken with 0.5ml of lead acetate solution and precipitate was observed.

Test for Phenol: One ml of aqueous and ethanolic extract was taken in test tube separately and few ml of ferric chloride solution was added. Appearance of dark green to black colouration of the solution is indication of presence of phenols.

Quantitative:

Test for Oxalate: This was determined using Dye method (Dye, 1956).2g each of sample was extracted with dilute HCL, 10ml concentrated ammonia and then precipitated with calcium chloride as calcium oxalate. The precipitate was then washed with 25ml of hot 25% sulphuric acid and dissolved in hot water and titrated with 0.05M potassium permagnet to determine the concentration of oxalate.

Spectrophotometric estimation of protein, carbohydrate and phenol: Protein estimation was done by following the method of Lowry et al (1951). For carbohydrate and phenol methods of Dubois et al (1956) respectively was followed using UV-vis spectrophotometer.

Detection of functional group: Presence of functional group in the sample was detected by FTIR. (Allen et al 1994)

Antibacterial assay of the shell extract: The shell extract was subjected to antibacterial test by disc diffusion method (Esteban et al 2005). For this study Pure culture of a pathogenic strain *Escherichia coli* . Nutrient agar was poured on 7 sterilized petriplates. In opaque vials 5ml of saline water was taken and sterilized by autoclaving at 121°C and 15lbs/inch^2 pressure for 15 minutes. The loop, full of isolated bacteria were transferred into the opaque vials and mixed well using vortex to develop turbidity. With the help of sterilised pipette, 1ml of each isolate was pipette

out and dropped on the plate. It was then evenly spread over the media with the help of sterile glass spreader. The plates were kept at room temperature for 15minutes to allow surface moisture to be absorbed before loading the impregnated discs. Then, 6 discs were loaded 3 containing aqueous extract and rest 3 ethanolic extract by means of sterile forceps, strictly under aseptic condition. The discs were placed on the plate are the centres. Then within 15 minutes discs were loaded, the plates were placed in incubator at 36°C for 24 hours (Tiwari et al 2011).

Removal of metals using Atomic Absorption Spectrophotometer: Sample solutions were prepared by adding the salts of Copper Sulphate and Zinc Chloride in water. Then these water samples were treated with different concentrations of ground nut husks and stirred for 1 hour in magnetic stirrer at 750rpm. After that these samples were subjected to Atomic Absorption Spectrophotometer to observe the metal absorption capacity of groundnut husk (Krowial et al 2011).

Result and discussion:

The phytochemical screening of the aqueous extract of the husks revealed that all the major constituent responsible for nutritional and antinutritional factors are found to be present in the husks. The results are depicted in table 1.

Phytochemical analysis of the husks extract of *Arachis hypogaea* showed the presence of primary as well as secondary metabolites, which are responsible for nutritional and antinutritional factors. Table I shows the presence of protein, carbohydrate, lipid content, oxalate , alkaloids, tannin, phenol. The result was found to be similar to that of the phytochemical screening reported by S.Abdulrazak. et al(2014).

As all the phytochemicals were detected in ethanolic extract, so estimation was done in ethanolic extract.

Estimation of oxalate- Result of titration shows the presence of oxalate which was estimated as 220 mg /100ml. The results were found to be similar to that of S.Abdulrazak et al(2014).

In table II the concentration of carbohydrate was estimated to be highest whereas, phenol concentration was least which were similar as to be reported by S Abdulrazak et al (2014).

The FTIR results have shown the presence of a functional group like tertiary amide in the sample.

The result of table III showed that the aqueous extract of the shell was ineffective as compared to ethanolic extract which shows the positive result in inhibiting the bacterial growth.

The treatment of water containing copper and zinc with groundnut shell was found to be effective to decrease the concentration of metals in the water samples. The copper concentration was reduced from 0.225µg/ml to 0.140µg/ml to 0.125µg/ml and zinc concentration was reduced from 0.024µg/ml to 0.016µg/ml to 0.010µg/ml. These results were found to be similar as reported by Isah et al (2012) for lead absorption.

Conclusion:

The present work revealed that groundnut husks are a rich source of many important components, that have good nutritional attributes, like carbohydrate, protein, lipid content, and appear to have a very positive effect on human and animal health. On the other hand, the presence of high levels of anti-nutritional factors like oxalate, alkaloids, tannins, phenols contents make them unhealthy also. Inhibition of bacterial growth by groundnut husks makes them a cheap anti-bacterial agent. These husks are also helpful in absorption of metals, which in turn can be used in treatment of waste water. Hence, more research work needs to be done in this field to bring forth the latent potential of the husks of groundnut shell which may prove to be as useful as its seed.

Acknowledgement:

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LIST OF TABLES

Table I. Phytochemical screening of husks extract of *Arachis hypogaea*

			Aqueous extract	Ethanolic extract
Nutritional factors	Primary metabolites	Protein	+	+
		Carbohydrate	+	+
		Lipid content	–	+
Anti-nutritional factors	Secondary metabolites	Oxalate	+	+
		Alkaloids	+	+
		Tannin	+	+
		Phenol	–	+

Present (+) Absent (–)

Table II. Estimation by UV-vis Spectrophotometer

Phytocompounds	Absorbance	Concentration
Protein	0.918	0.915mg/ml
Carbohydrate	3.037	4.3mg/ml
Phenol	0.437	0.41mg/ml

Table III. Antibacterial potential of groundnut shell

Sample	Strain	Bioassay
Aqueous extract	*Escherichia coli*	Ineffective
Ethanolic extract	*Escherichia coli*	Partially Effective

Table IV: Absorption of Copper by groundnut shell

	Water sample	After treatment with husk (1g/100ml)	After treatment with husk (2g/100ml)
Mean absorbance of Copper	0.0044	0.0157	0.0139
Concentration of Copper	0.225µg/ml	0.140µg/ml	0.125µg/ml
Mean absorbance of Zinc	0.0253	0.0171	0.0111
Concentration of Zinc	0.024µg/ml	0.016µg/ml	0.010µg/ml

LIST OF GRAPHS

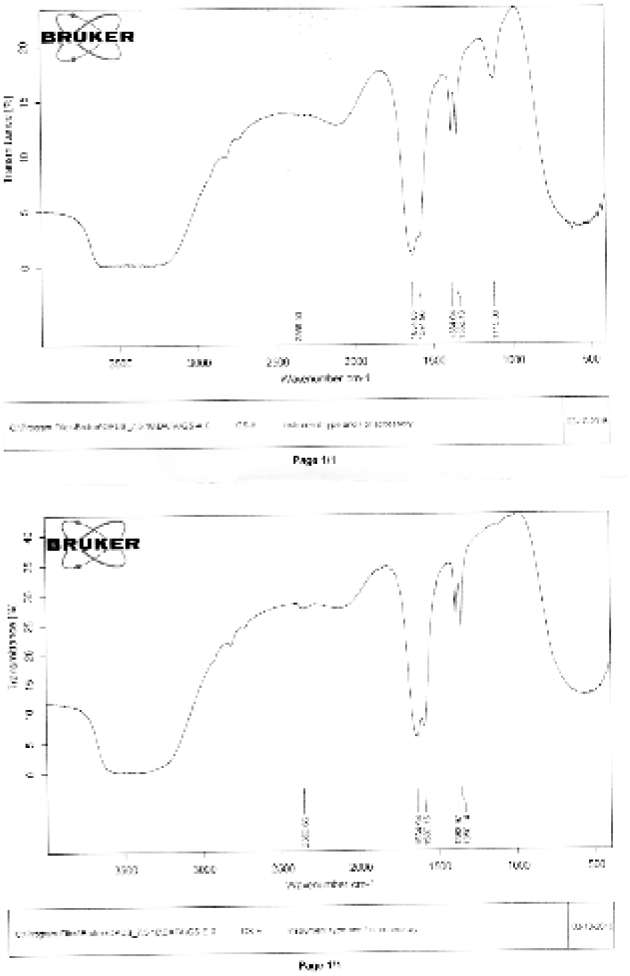
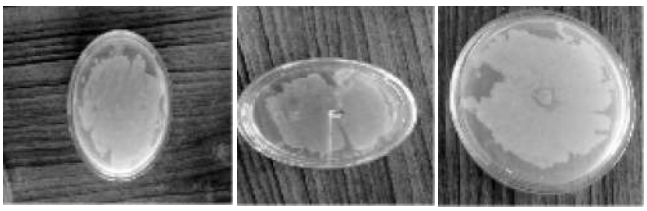
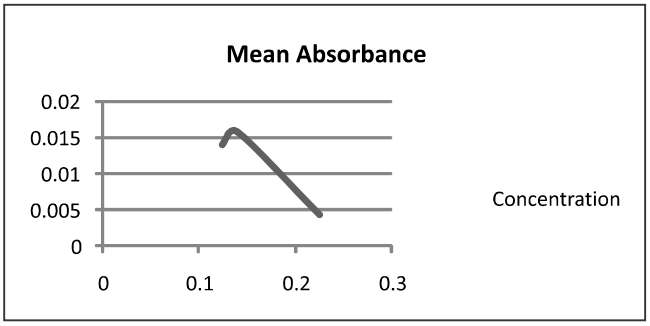


Fig. 1. Absorbance peak spectrum



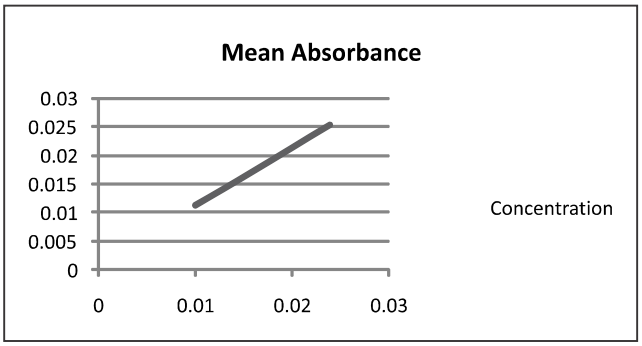
(A) (B) (C)

Fig. 2. (A) Negative control (B) Ineffective (C) Partially effective Bioassay of antibacterial potential of groundnut shell against *Escherichia coli*



x-axis - concentration
y-axis - mean absorbance

Figure 3: Absorbance of Copper by treating water samples with different concentration of groundnut shell



x-axis - concentration
y-axis - mean absorbance

Fig. 4. Absorbance of Zinc by treating water samples with different concentration of groundnut shell

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