Nutritional Compositions, Antibacterial Activities, Antioxidant Activity And Acute Toxicity Of Roots Of Cassava

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Abstract

The roots of cassava are the vegetables widely consumed in developing countries. The roots provide some important nutrients and starch which may have health benefits. Modified cassava starch is produced, mainly in Asia, for the production of sweeteners, fructose, alcohol and monosodium glutamate. In this research work, the roots of cassava were collected from Lashio Township, Shan State, Myanmar. Preliminary detection of phytochemical compounds present in the roots of cassava were carried out by phytochemical tests. The mineral contents of the roots of cassava were determined by applying EDXRF (Energy Dispersive X-ray Fluorescence) method. The nutritional compositions of the roots sample were determined. The antibacterial activities of the crude extracts of the roots sample were examined by ager-well diffusion method on six microorganisms such as *Bacillus cereus*, *Staphylococcus aureus*, *Pseudomonas aeruginosa*, *Esherichia coli*, *Salmonella typhii*, and*Shigellaboydii*. The antioxidant activity of ethanol extract of roots sample was determined by DPPH (1, 1 diphenyl-2-picryl hydrazyl) assay. The acute toxicity of water extract of roots sample was also investigated

Keywords: nutritional compositions, phytochemical, extracts, antioxidant

Introduction

***Manihotesculenta*Crantz**, with common name,**Cassava**, is a perennial woody shrub of the family, *Euphorbiaceae*, native to South America. The term cassava is usually applied in Europe and the United States of America to the roots of the cassava plant, whereas tapioca denotes baked products of cassava flour. Cassava is the fourth supplier of dietary energy in the tropics and the ninth world-wide. Its cultivation and processing provide household food security, income and employment opportunities for 500 million people in Africa, Asia and the America. However, in communities having access to markets, cassava can become a source of income and employment for both men and women.(MasekJ.,1966)

Cassava is grown by smallholder farmers in more than 100 tropical and subtropical countries. The roots of cassava can be consumed fresh after cooking, processed into food products, or fed to livestock. Modified cassava starch is produced, mainly in Asia, for use as feedstock for production of sweeteners, fructose, alcohol and monosodium glutamate, and textiles. Cassava root starch can be used in a wide array of industries, from food manufacturing and pharmaceuticals to production of plywood, paper and bio-ethanol.(FAO,1995)

Cassava is not commonly used in herbal medicine, but indigenous people do employ it for various healing purposes. The leaves can be used as a styptic, while the starch mixed with rum has been used for skin problems, especially for children. Other indigenous uses include preparations for fever and chills, to treat sterile women and as an application for sore muscles. Folk medicine is employing both leaves and pulped roots as an application for tumors. Cassava may be a useful source of starch for people who are suffering from coeliac disease. However, people who are allergic to latex should avoid this plant.(James A., *et al*,1983)

In this research work, study on the nutritional compositions, antibacterial activities, acute toxicity and antioxidant activity of roots of cassava were carried out.

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Materials and Methods

Sample Collection

The roots of cassava were collected from Lashio Township, Shan State, Myanmar. Firstly, they were cleaned, peeled and chopped into small pieces and dried at 40C in the oven. The dried samples were then ground into powder by electric grinder. Then, the powder was weighed and it was stored in a bottle throughout the experiment.

Preliminary Phytochemical Tests

Preliminary detection of phytochemical compounds present in the rootsof cassava was carried out according to phytochemical methods.

Determination of Nutritional Compositions

Mineral contents of the roots of cassava were studied by applying EDXRF (Energy Dispersive X-ray Fluorescence Spectroscopy) method. The moisture content of root sample was determined by oven drying method. The ash content of the cassava roots was measured by oven drying method. The crude fiber content of the rootsample was examined by acid and alkaline digestic method. The oil content of the roots of cassava was determined by soxhlet extraction method. The protein content of the root sample was analysed by using Kjelahl's method (AOAC, 2000). The soluble carbohydrate content was tested by phenol-sulphuric acid, colorimetric method in terms of glucose (James N. *etal*, 2009).

Determination of Antibacterial Activities

For the measurement of antibacterial activities, the three solvents extracts of roots of cassava were used. The antibacterial activities were determined by agar-well diffusion method.

Determination of Antioxidant Activity

DPPH (1,1-diphenyl-2-picryl-hydrazyl) radical scavenging assay was chosen to assess the antioxidant activity of ethanol extract of the roots of cassava.

Determination of Acute Toxicity

The acute toxicity of the water extract of the roots of cassava was determined by using the mice.

Results and Discussion

The results of phytochemical tests of the roots of cassava were described in Table (1).

Table (1) Results of Phytochemical Constituents

No.	Constituents	Extract	Reagents Used	Observation	Result
1	Alkaloids	1% HCL	(i) Wagner's reagent (ii)Dragendroff'reagent	(i) Reddish brown ppt (ii)Orange ppt	+ +
2	Flavonoids	95%ethanol	conc: HCl, Mg	Pink colour solution	+
3	Glycosides	water	10% lead acetate	White ppt	+
4	Phenolic	water	10% $FeCl_3$	Purplish colour solution	+
5	Polyphenols	95% ethanol	1% $FeCl_3$ + 1% $K_3[Fe(CN)_6]$	Green blue colour solution	+
6	Reducingsugars	water	Benedict's solution	Orange-red ppt	+
7	Saponins	water	Distilled water	Froth like comb	+
8	Steroids	95% ethanol	$CHCl_3$, acetic anhydride, conc: H_2SO_4	Green color solution	+
9	Tannins	95% ethanol	10% $FeCl_3$,dil H_2SO_4	No brown ppt	+
10	Terpenes	pet-ether	$CHCl_3$, acetic anhydride, conc: H_2SO_4	No Pink colour solution	-

According to the Table(1), the roots of cassava consisted of alkaloids, flavonoids, phenolic compounds, polyphenols, reducing sugars, saponins, steroids and glycosides, respectively.Therefore, the root sample contained valuable phytochemical constituents for human's health.

The results of elemental analysis of the roots of cassava were described in Table (2).

Table (2) The Results of Elemental Analysis

No.	Elements	Symbols	Relative abundance %
1.	Potassium	K	0.5685
2.	Calcium	Ca	0.1091
3.	Chlorine	Cl	0.0791
4.	Phosphorous	P	0.0736
5.	Aluminum	Al	0.0243
6.	Silicon	Si	0.0190
7.	Iron	Fe	0.0109
8.	Sulfur	S	0.0083
9.	Titanium	Ti	0.0052
10.	Vanadium	V	0.0027
11.	Manganese	Mn	0.0014
12.	Zinc	Zn	0.0012

Table(2) shows that K, Ca, Cl, P, Al, Si, Fe, S, Ti, V, Mn and Zn were found in the roots of cassava. Among them, potassium was the highest amount in the root sample. It indicated that the roots of cassava were the rich source of minerals for health benefit.

The study of nutritional compositions such as moisture, ash, crude fibre, oil, protein and soluble carbohydrateof the roots ofcassava was performed. These results were tabulated in Table (3).

Table (3) TheNutritional Compositions

No.	Nutritional Value	Yield %
1	Moisture content	4.6
2	Ash content	1.1
3	Crude fibre content	1.8
4	Oil content	1.4
5	Protein content	1.6
6	Soluble carbohydrate content	38.3

According to Table (3), it was found that the roots of cassava contained valuable nutritional compositions which would have benefits to humans. Among them, soluble carbohydrate content was found to be the highest value (38.3%) in the roots of cassava. The results of the antibacterial activities of the roots of cassava were tabulated in Table (4).

Table (4)The Results of Antibacterial Activities

		Inhibition Zone					
Samples	**Solvents**	**I**	**II**	**III**	**IV**	**V**	**VI**
cassiva	n-hexane	4 mm(+)	2 mm(+)	5 mm(+)	7 mm(+)	4mm(+)	7 mm(+)
	EtOAc	2 mm(+)	9mm(++)	8mm(++)	8mm(++)	3 mm(+)	3 mm (+)
	EtOH	1 mm(+)	1mm(+)	9mm(++)	8mm(++)	4mm(+)	3 mm(+)

Clear zone diameter
well diameter = 5 mm
5 mm – 7 mm = (+)
above 7 mm = (++)

Organisms
I. *Bacillus cereus*II. *Escherichia coli*
III. *Pseudomonusaeruginosa*IV.*Staphylococcus aureus*
V. *Shigellaboydii*VI.*Salmonelltyphii*

According to the experimental data, n-hexane extract of root sample showed lowactivity on all tested organisms. Ethyl acetate extract gave rise to medium activities on *Escherichia coli*, *Pseudomonusaeruginosa*,*Staphylococcus aureus*and low activity on *Bacillus cereus*,*Shigellaboydii*,*Salmonellatyphii*. The ethanol extract of the root sample had medium activity on*Pseudomonusaeruginosa*,*Staphylococcus aureus*and low activity on*Escherichia coli*,*Bacillus cereus*,*Shigellaboydii*, *Salmonella typhii*.

The antioxidant activity of ethanol extract of the roots of cassavawas measured using standard ascorbic acid.The % inhibition and IC_{50} values of standard ascorbic acid were shown in Table (5) and Figure (1).

Table (5) The% Inhibition and IC_{50} Values of Standard Ascorbic Acid

Concentrarion (µg/ml)	Mean Absorbance	Mean % Inhibition	IC_{50}
100	0.0276	99.97	**11.98µg/ml**
50	0.0628	89.936	
2.5	0.224	64.103	
12.5	0.288	53.840	
6.25	0.341	45.350	
3.125	0.397	36.378	

IC_{50} value was calculated by using linear regressive equation.

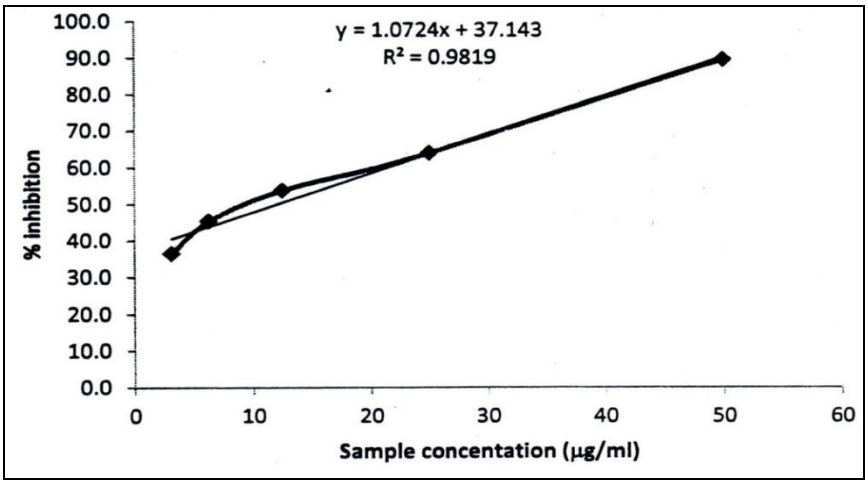

Figure (1) The% Inhibition vs. Concentration (µg/ml) ofStandard Ascorbic Acid

The % inhibition and IC_{50} values of roots of cassava were shown in Table (6) and Figure (2).

Table (6)The % Inhibition and IC_{50} Values of Ethanol Extract of the Roots of Cassava

Concentration (µg/mL)	Mean Absorbance	Mean % inhibition	IC_{50}(µg/mL)
60	0.382	50.20	56.08
50	0.391	49.02	
40	0.415	45.89	
30	0.445	41.98	
20	0.464	39.50	
10	0.491	35.98	

IC_{50} value was calculated by using linear regressive equation.

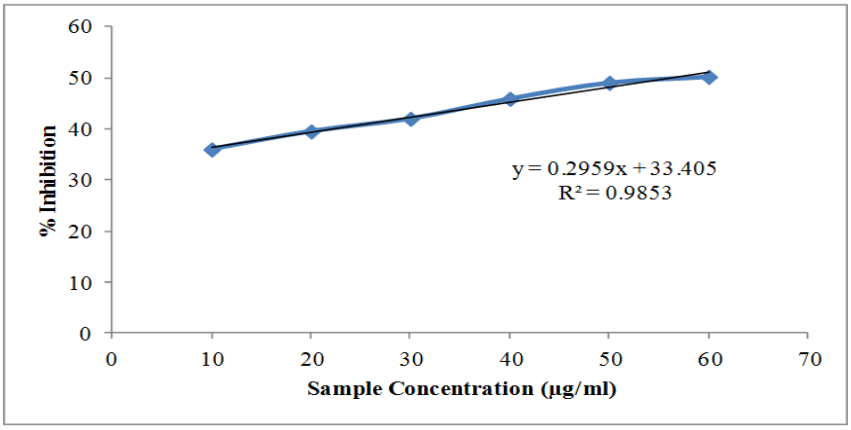

Figure (2) The% Inhibition vs. Concentration (µg/ml) of Ethanol Extract of the Roots of Cassava

From the Table (5) and (6), it was found that ethanol extract of root sample (IC_{50} = 56.08 µg/ml) has lower antioxidant activity than standard ascorbic acid (IC_{50} = 11.98 µg/ ml).

The toxicity of water extract of the roots of cassavawas shown in Table (7).

Table (7) Results of Acute Toxicity Test

No.	Dose	Tested Mice	Dead	Alive
1.	500 mg/kg/day	5	-	5
2.	1000 mg/kg/day	5	-	5
3.	1500 mg/kg/day	5	-	5
4.	2000 mg/kg/day	5	-	5
5.	2500 mg/kg/day	5	-	5

The Table (7) showed that the water extract of the root sample, 500, 1000, 1500, 2000 and 2500 mg/kg/day doses gave healthy mice. Their behaviors were normal condition. They were survived till 10 days after administration. No mortalities were observed among the mice tested with water extract.Therefore, it was found that 500, 1000,1500, 2000 and 2500 mg/kg/day of water extract of the roots of cassava would be confidence dose.

Conclusion

In this research work, the roots of cassava were selected for the chemical analysis. From the phytochemical tests, it was known that the root sample gave positive tests for alkaloids, flavonoids, phenolic compound, polyphenols, and glycosides, reducing sugars, tannins and saponins, respectively. The phytochemical analysis indicated that the roots of cassava contained valuable phytochemical constituents.

Elemental analysis indicated that potassium was the highest amount in root sample. The nutritional compositions such as moisture, ash, crude fibre, oil, nitrogen, protein and soluble carbohydrate were studied. From these studies, the soluble carbohydrate content was found to be the highest amount (38.3%) in the roots of cassava.

In the study of antibacterial activities of three solvents extracts of root sample, ethyl acetate and ethanol extracts gave rise to medium activities on *Pseudomonusaeruginosa*, *Staphylococcus aureus*.

In addition, the determination of antioxidant activity of ethanol extract of the roots of cassava was done. Ascorbic acid was used as a standard antioxidant. It was found that ethanol extract of root sample (IC_{50} = 56.08 µg/ml) has lower antioxidant activity than standard ascorbic acid (IC_{50} = 11.98 µg/ ml).

According to the results of acute toxicity test, no mortalities were observed among the mice tested with 500, 1000, 1500, 2000 and 2500 mg/kg/day dose of water extract. The water extract of roots of cassava gave the normal condition of their health. Therefore, the water extract of the root sample has no toxic effect and it showed confidence dose and considered as safe.

From the experimental data, it can be seen that, the roots of cassava were rich in nutrients compositions which was responsible for health benefits to humans.

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