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Anti-Bacterial, Phytochemical Analysis and Blood Pressure Lowering Effects of Orange Flesh Sweet Potatoes (Ipomoea Batatas L.)

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Abstract: Aim; The use of natural or alternative medicines has increased markedly over the last few years. The practice started in Africa quite a while past before the disclosure of even chemotherapeutics. With time, the practice spread to Asian nations and different parts of the world. Over the previous century it has gotten more consideration from places like Europe and the United States of America and has been utilized all the more widely in treating different infirmities. In view of considering the efficacy of traditional medicines, this study aims at assessing the Phytochemical and Antibacterial property of fresh and fermented Ipomoea batatas L. against selected test microorganisms. **Methods:** The Antibacterial efficacy was tested using the agar-well diffusion technique. The Minimum Inhibitory Concentration (MIC) and Minimum Bactericidal Concentration (MBC) of the extracts were also determined. Phytochemical examination of the hot, cold and fermented extracts was also analyzed using standard methods. **Results:** Results obtained uncovered that the Antibacterial activities in cold extracts were more effective than the hot extract. Cold extracts of Ipomoea batatas L. tuber has Antibacterial activity against Staphylococcus aureus, Streptococcus pyogenes and Escherichia coli. Hot extracts (HE) of Ipomoea batatas L. bark have Antibacterial activity against Serratia marcescens. Cold extracts of Ipomoea batatas L. tuber was bactericidal for S. aureus at 900mg/ml and 450mg/ml, making 450mg/ml the MBC. CE of Ipomoea batatas L. bark, CE of Ipomoea batatas L. leaf, HE of Ipomoea batatas L. tuber and CE of Ipomoea batatas L. stem was tested against Staphylococcus aureus, Escherichia coli and Streptococcus pyogenes respectively and all organisms came out resistant. The phytochemical analysis of the non-fermented sample uncovered the presence of saponins, flavonoids, anthraquinones, tannins, glycosides and phenol. The fermented Ipomoea batatas L. flour revealed the presence of phenols, flavonoids, tannins and alkaloid while the fermented juice revealed the presence of only alkaloid. It was likewise discovered that Ipomoea batatas L. stabilized the blood pressure and blood levels of people at Kpaduma town in Guzape. **Conclusion:** Ipomoea batatas L. contains phytochemicals, according to this study. The plant has antibacterial activities against Staphylococcus aureus, Escherichia coli, Streptococcus pyogenes and Serretiamarcesens, indicating that it can be utilized

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as an antibacterial. In addition, Ipomoea batatas L. has been shown to be useful in the controlling of high blood pressure and blood sugar levels.

Keywords: OFSP- orange flesh sweet potato, staphylococcus, phytochemicals, antibacterial and blood pressure

1. Introduction

Sweet potatoes are claimed to be a Central American native and one of the world's oldest veggies. Sweet potato remnants discovered in Peruvian caverns dating back 10,000 years show that they have been consumed from prehistoric times. After his first expedition to the New World in 1492, Christopher Columbus brought sweet potatoes to Europe. They were transported to the Philippines by the Spanish in the 16th century, then to Africa, India, Indonesia, and southern Asia by the Portuguese. To distinguish it from other sweet potato types, the orange fleshed sweet potato (OFSP), also known as *Ipomoea batatas L*, was introduced in the United States as "yams." Sweet potatoes are prominent in many Asian and Latin American cultures, with China, Indonesia, Vietnam, Japan, India, and Uganda being major producers and exporters of OFSP.

OFSP was brought to Nigeria from Peru in South America, namely the North Central region. It was studied by the National Root Crop Research Institute Umudike in order to domesticate it, and it was discovered that it can grow anywhere in Nigeria on marginal soil. It doesn't necessitate a lot of soil nutrients. Since then, there have been various initiatives in Abuja on OFSP cultivation, including the Rainbow Project of the Federal Ministry of Agriculture from 2014 to 2017, but the plant was not generally known until Esonu Udeala got into it and began growing it and raising awareness of its importance and health advantage Since then, local experiments have demonstrated that it can improve high blood pressure, high sugar levels, and provide relief from constipation. Anemic individuals should take the leaves because they are high in vitamins and phytochemicals. It can also be used as a vegetable in soups and sauces [1]. As a result, there's a good chance that this subsistence crop will be embraced as part of the consumer food chain's regular diet, supplementing as a staple food supply for resource-poor farmers in an era of rapid population increase and nutritional crises. However, many people are unaware of the nutritional advantages of certain high-yielding orange-fleshed sweet potato cultivars. Furthermore, the biochemical composition of orange-fleshed sweet potato genotypes differs [2]. The Orange Fleshed Sweet Potato (*Ipomoea batatas L.*) is a key Asian root crop that is now planted all over the world, especially in tropical and subtropical nations like Nigeria. Asia accounts for around 78 percent of the world's cropland and 92 percent of global production [3]. India, along with China, America, Brazil, Peru, Mexico, and Thailand, is a major producer of this crop [4]. China is the world's greatest sweet potato producer and consumer, accounting for roughly 67 percent of worldwide area and 86 percent of global production manufacturing [5]. South Asia accounts for roughly 68 percent of total sweet potato production, with Bangladesh accounting for 27 percent and Sri Lanka for about 5%. Sweet potatoes are grown mostly in Orissa, Uttar Pradesh, West Bengal, Bihar, Karnataka, Tamil Nadu, and Kerala in India [6]. Starch, carbohydrates, minerals, and vitamins abound in sweet potato tubers. The orange-fleshed sweet potato, which is high in -carotene and has various physiological properties such as anti-oxidation, anti-cancer, and protection against liver injury, is gaining popularity as a bio-fortified crop to combat hunger in small and marginal farming communities [7]. The orange fleshed sweet potato has significant potential to contribute to a food-based strategy to addressing vitamin A deficiency, which is a serious public health concern in the poorer portions of the population.

Consumption of boiling roots enhanced the vitamin A marker in adults and children, according to studies. In Nigeria, despite its nutritional potential, OFSP is underutilized in comparison to other root and tuber crops. Based on Ghanaian customer acceptance ratings, OFSP has been determined to be a good composite to wheat flour when pureed for bread making at 30% substitution. Aside from their high vitamin A content, investigations have revealed that they contain a high -carotene content and greater levels of -carotene. Other phytochemicals such as flavonoids, phenolics, and anthocyanins may alter the quality and stability of processed foods. These phytochemicals have been shown to promote human health by acting as an antagonist against chronic diseases and malignancies, such as cardiovascular disease (CVD), high blood pressure, type II diabetes, and decreased cognitive function [1]. They are regarded essential components in a number of nutraceuticals, pharmacological, medical, and cosmetic uses due to their ability to prevent chronic diseases Medicinal plants are plants that are used for the prevention and treatment of illnesses and infections. Many of our plants, for example, are utilized in herbal medicine to treat ailments and injuries in Nigeria. The use of 'natural' or alternative treatments has risen dramatically in recent years. On the idea that these substances will have a favorable effect, an increasing number of older persons (i.e., baby boomers) are utilizing complementary and alternative medicine nutritional supplements and herbal medicines without consulting a physician [8]. This, however, may not be a safe or prudent approach. For example, at least one recent survey found a substantial problem with herb-chemotherapeutic drug interactions in cancer patients, with at least one patient dying as a result of one of these interactions. At least half of the herbal treatments used by these individuals lacked research evidence on possible interactions [9].

The goal of this study is to determine the phytochemical and antibacterial effects of fresh and fermented *Ipomoea batatas L.* plant extract on selected bacteria pathogens present in North-Central Nigeria. It focused on the phytochemical components and antibacterial properties of extracts from *Ipomoea batatas L.* leaves, stem, back, and tuber on chosen test microorganisms. The findings of this study will be used to offer recommendations for future research and development, as well as the use of *Ipomoea batatas L.* for therapeutic purposes.

Figure 1. OFSP Tuber.

Figure 2. OFSP leaves.

2. Materials and Methods

2.1. Sample Collection and Extraction (Cold Extract (CE))

Esonu Udeala's farm in Abuja, North Central Nigeria, provided fresh leaves, stems, and tubers of Ipomoea batatas L. The specimen was properly cleaned with clean water, sun-dried, and then homogenized separately with an electric blender. 30 g of homogenized tuber, stem, and leaves were steeped in 100 cc of methanol and left for 48 hours. For 6 hours, each preparation was shaken every 30 minutes and let to stand for 48 hours. Whatman No 1 filter paper was used to filter each preparation. Using a rotary evaporator, the filtrates were concentrated to dryness (semi solid) in vacuo at 40°C (Bibby Sterlin Ltd, England, and RE. 2000). The weight of the yield and the beginning weight of the powder extracted were compared to determine the percentage yield of each extract. Prior to usage, the extract was kept in the refrigerator at a temperature of 4°C.

2.2. Alcohol Soxhlet Extraction Method (Hot Extract (HE))

The homogenized *Ipomoea batatas L.* leaves were placed in a thimble separately. A circular bottom flask was filled with 100mI methanol and attached to the soxhlet extractor. A condenser attached to the soxhlet extractor heated this setup. The extracts exhibited influx and efflux reactions as they heated. This operation was repeated up to four times until all of the leaves' contents had been extracted. The tuber, back, leaves, and stem of *Ipomoea batatas L.* were all subjected to the same process from step I to step 5. The back, root, tuber, and stem mixture methanol extracts were obtained in the same way. Using a rotary evaporator, the extracts were concentrated to dryness (semi solid) in vacuo at 40°C (Bibby Sterlin Ltd, England, and RE. 2000). The weight of the yield and the beginning weight of the powder extracted were compared to determine the percentage yield of each extract. Prior to usage, the extract was kept in the refrigerator at a temperature of 4°C.

2.3. Sterility Tests for the Extracts

The extracts were examined for contaminant growth. A loopful of each extract was aseptically inoculated onto Nutrient Agar and incubated for 24 hours at 37 0C. Any signs of apparent growth were looked for on the plates. The absence of growth on the plates meant the extracts were sterile.

2.4. Dilution of the Extracts

The CE leaf extracts were diluted in the following concentrations: 900 mg/ml, 450 mg/ml, 225 mg/ml, 112.5 mg/ml, 56.25 mg/ml, and 28.13 mg/ml. 500 mg/ml, 250 mg/ml, 125 mg/ml, 62.5 mg/ml, 31.25 mg/ml, and 15.63 mg/ml for the leaf, stem, bark, and tuber HEs. 425 mg/ml, 212.5 mg/ml, 106.25 mg/ml, 53.13 mg/ml, 26.56 mg/ml, and 13.28 mg/ml for the bark CE. 500 mg/ml, 250 mg/ml, 125 mg/ml, 62.5 mg/ml, 31.25 mg/ml, and 15.63 mg/ml for the stem CE.

2.5. Collection of Bacterial Isolates

Clinical bacterial isolates were collected from Veritas University's Microbiology Laboratory in Abuja. *Staphylococcus aureus, Escherichia coli, Serratia marcescens, and Streptococcus pyogenes* are among these bacteria. Cultural, morphological, and biochemical tests were used to validate their identity. The bacterial isolates were kept at 4 degrees Celsius on nutrient agar slant.

2.6. Inoculum Size Standardization

The McFarland standard was utilized to prepare all bacterial isolates. This was accomplished by inoculating the organism with 0.05 mL of 1.175 percent Barium Chloride and 9.95 mL of 1% Sulphuric acid.

3. Biochemical Identification of the Test Organism

Escherichia coli.

E. coli was grown for 18 hours on Eosin Methylene Blue agar. Colonies with a green metallic shine were discovered, indicating an E. coli positive result.

Staphylococcus aureus.

S. aureus was grown for 18 hours on Mannitol Salt Agar (MSA). A positive result for S. aureus is indicated by smooth round colonies with a yellow color.

4. Evaluation of Antibacterial Activity using Agar Well Diffusion Method

A Muller Hinton Agar plate was made according to the manufacturer's instructions and deposited into a petri dish in a 20 m1 amount. With a sterilized glass spreader, a loopful of the test organism from the tube containing 10^2cfu/ml concentration of each of the test isolates was distributed on the surface of the 20 ml Mueller Hinton Agar plate. These were left to pre-diffuse for 30 minutes before drilling an 8 mm diameter hole in each of the agar plates holding the isolates with a Number four cork borer. Ciprofloxacin was utilized as a control and a volume of 0.02 ml (20 u1) of each extract was used to fill the agar wells formed in the Muller Hinton agar plates. The plates were let to stand for an hour to allow the drug to pre-diffuse into the agar before being incubated for 24 hours at 37 °C. The zones of inhibition were classified as resistant or susceptible after incubation, based on the criteria for viable antibacterial activity in plant extracts. D1 8 mm is considered vulnerable, whereas D1 8 mm is considered resistant. Only extracts with apparent zones of inhibition against the test organism greater than D1 8 mm were used to calculate the minimum inhibitory concentration.

4.1. Determination of Minimum Inhibitory Concentration (MIC in mg/ml) using the Tube Dilution Method

For the methanol leaf, stem, back, and tuber extracts, the MIC was calculated.

Dilution of the Extracts.

The initial concentration of the Ipomoea batatas L extracts was 500 mg/ml; hence a 1 in 2 dilution was used to produce a 250 mg/ml extract concentration. Each extract was placed in a row of six test tubes. Pipette 1ml sterile Nutrient broth into the tubes. 1 ml of 250 mg/ml *Ipomoea batatas L.*extract was pipette into each of the six tubes. A doubling dilution was made in 1 mI increments from tube 1 to tube 6 to obtain the concentrations of 250 mg/ml, 125 mg/ml, 62.5 mg/ml, 31.25 mg/mI, and 15.63 mg/ml, respectively. A loop of isolate was pipetted into tubes 1 to 6. The remaining isolates were treated in the same way. The tubes were incubated for 18-24 hours at 37°C. Turbidity or cloudiness was noticed, indicating a favorable result. The extract's MIC is the lowest concentration with no turbidity. For the bark extract, stem extract, leaf extract, and tuber extract, procedures 4-11 were repeated.

Mode of action of the extracts.

Any plate with no visible growth on the nutrient agar (NA) indicated bactericidal effect of the concentration of the extract used. Plates showing scanty growth indicated the bacteriostatic effects of the extract concentration. Concentrations of the extracts which show moderate and heavy growth were considered to have no inhibitory effect on the organism.

Control.

The positive and negative controls were gentamicin and distilled water, respectively.

Ipomoea batatas L. for High B.P and Low Blood Sugar

Individuals in a village in Nigeria's North Central region with high blood sugar levels using a glucometer and high blood pressure using an Accuson Sphygmomanometer were given the raw tuber of Ipomoea batatas L. to consume uncooked for 5 days after assessing their blood pressure and glucose levels. They were re-tested after 5 days to see if the results had improved.

4.2. Procedure for Quantitative phytochemical screening of Fermented OFSP Juice

Test for Alkaloids.

0.5g of leaves were dissolved in a mixture of 96 percent ethanol and 20 percent tetraoxosulphate (vi)acid (1:1) 1 mL of the filtrate was mixed with 5 mL of 60 percent tetraoxosulphate (vi) acid for 5 minutes. After that, 2ml of 0.5 percent formaldehyde was added and let to sit for 3 hours. The reading was taken at 565nm absorbance.

Test for flavonoids.

The flavonoids on the leaves sample were determined using an acid hydrolysis spectrophotometric technique. 0.5 grams of processed leaves were combined with 5 milliliters of weak hydrochloric acid and heated for 10 minutes. After allowing the boiling extract to cool, it was filtered. 5ml ethyl acetate and 5ml 1 percent ammonium hydroxide were mixed with 1ml filtrate. This was the absorbance scan from 420 to 520nm.

Saponin test.

0.5g of the material was boiled in 20ml of 1NHCL for four hours. After cooling, 50ml of pet ether was added to the filtrate for the ether layer, which was then evaporated to dryness. The residue was treated with 5ml of acetone-ethanol. 6ml ferric sulphate reagent was added to three test tubes containing 0.4ml of each, followed by 2ml conc. Tetraoxosulphate (vi) acid. After 10 minutes, it was well mixed, and the absorbance was measured at 490nm.

Phenol test.

The spectrophotometer method is used to determine the amount of phenol. For 15 minutes, the leaves sample is cooked in 50ml of pet spirit. 5ml of the cooked sample is pipetted into a 50ml flask, followed by 5ml of distilled water. 2ml ammonium hydroxide solution and 5ml butanol are added to the mixture after the distilled water is added. The leaves sample was prepared up to the mark and left for 30 minutes to react for color development before being measured using a spectrophotometer at 505nm wavelength.

Tannins test.

The spectrophotometric approach is used to determine the quantity of tannins. A 0.5g sample of leaves is weighed into a plastic bottle. 50ml distilled water is added, and the mixture is agitated for 1 hour. The sample is filtered and made up to specification in a 50ml volumetric flask. 5ml of the filtered material was pipette into a test tube, where it was combined with 2ml of 0.1MHCl and 0.008M K4Fe (CN) 6.3H2O. Within 10 minutes, the absorbance is measured with a spectrophotometer at 395nm wavelength.

4.3. Procedure for Qualitative Phytochemical Analysis

Fermentation of Orange Fleshed Sweet Potato Tuber.

The of the unpeeled OFSP tuber or root was soaked in water for 3days, sieved, the juice and the residue was air dried to get the fermented flour. Qualitative analysis was carried out on the juice while quantitative phytochemical analysis was carried out on the dried flour.

Tannins were tested by mixing about 0.5g of extract with about 10mls of distilled water and then filtering it. In 2ml of the filtrate, a few drops of 1 percent ferric chloride solution were added. The presence of tannins is indicated by the presence of a blue-black, green, or blue-green precipitate [10].

Check for steroid and triterpene compounds.

Test of Salkowski: A few drops of conc. H2SO4 were added to a mixture of crude extract and chloroform. Allow to stand for a while after shaking properly. The presence of steroids was indicated by the red color in the lower layer, whereas the presence of triterpenoids was shown by the creation of a yellow colored layer [10].

Glycosides test.

Test of Borntrager: 200 mg crude extract was cooked for 5 minutes with 2 ml dilute sulphuric acid and 2 ml 5 percent aqueous ferric chloride solution, resulting in anthroquinones, showing the presence of glycosides [10].

Antraquinones test.

The Borntrager Test After shaking 0.2g of extract with 10ml of benzene and filtering it, 0.5 ml of 1% ammonia solution was added to the filtrate and shaken again. The existence of free anthraquinones was determined by the appearance of a pink, red, or violet color in the ammonical (lower phase) [10].

Saponin testing.

1g of extract was cooked with 5ml distilled water and filtered to test for saponins. About 3ml distilled water was added to the filter and forcefully agitated for about 5 minutes. The presence of saponins was determined by frothing that persisted after heat [10].

Phenol testing.

In a methanol/water mixture, 0.5g of the extract was added to 1 percent ferric (III) chloride (1:1). The presence of phenols is indicated by a dirty green precipitate).

Terpenoids test.

1ml of sample extract was combined with 0.5ml of acetic anhydride and a few drops of concentrated H_2SO4.

The presence of terpenoids is indicated by a blue green precipitate.

Carbohydrate testing.

Fehling's Sugar Reduction Test: In a test tube, 5ml of fehling's solution A and B were mixed in equal parts with 2ml of test extract. The mixture was then boiled for 2 minutes. A positive test is indicated by a brick red ppt of copper (i) oxide.

Flavonoids testing.

A tiny amount of each test extract was dissolved in dilute NaOH separately. The presence of flavonoids is indicated by a yellow solution that turns colorless when con. HCl is added.

Cardiac Glycosides Test.

1 drop of ferric chloride solution was added to 0.5g of the extract in 2ml glacial acetic acid. With 2ml of concentrated sulphuric acid, this was minimized. The presence of deoxy sugar properties of Cardiac glycosides is indicated by the creation of a brown ring at the interphase.

Phlobatannin testing.

1ml of extract was heated with a few drops of 1 percent HCl. The presence of phlobatannins is indicated by a reddish precipitate.

Test for Resins.

Colophony resins are made from 2ml of extract and an equal volume of acetic anhydride solution, followed by drops of concentrated H_2SO4 (violet coloration indicates the presence of resins).

Balsams testing.

3 drops of alcoholic $FeCl_3$ are added to 4ml of extract before it is heated. The coloration turns dark green.

Volatile oils test.

Dilute 0.1M HCl NaOH was used to shake a small portion of the sample with volatile oils, a white ppt is created.

Glucose Test.

Accucheck active glucometer was used to estimate the fasting blood glucose level of 20 randomly selected diabetic patients and those with mean fasting blood glucose level>± 7.0 were placed on 2kg of uncooked OFSP daily for 5days and fasting glucose level was rechecked.

High Blood Pressure Check.

Accuson sphygmomanometer and stethoscope was used to estimate the blood pressure (Bp) level of 20 randomly selected hypertensive patients in Kpaduma Village, Asokoro, Abuja and those with

systolic above 150 and Diastolic above 90 were placed on 2kg ofuncooked OFSP daily for 5days and their BP rechecked.

Statistical Analysis.

Statistical Package for Social Sciences (SPSS) version 20.0 was used to analyze the data. To see if there was any significance among the solutions, the researchers used one-way Analysis of Variance (ANOVA). The p-value was used in statistical significance tests to estimate the role of chance. The null hypothesis was rejected with a p-value of 0.05 in this investigation.

5. Results

The phytochemical components of Ipomoea batatas L. are listed in Table 1 (OFSP). Flavonoids, Phenol, and Glycosides are present in heated leaf extracts, while Saponins, Anthroquinone, Phylobataning, Alkaloids, and Tannins are absent. Saponins, Anthroquinone, Tannins, and Glycosides are present in the cold extracts, but Flavonoids, Phenol, Phylobataning, and Alkaloids are absent. Flavonoids, Phenol, and Glycosides are present in hot stem extracts, while Saponins, Anthroquinone, Phylobataning, Alkaloids, and Tannins are absent. Flavonoids, Anthroquinone, Phenol, and Tannins are present in the cold extracts, while Saponins, Phylobataning, Alkaloids, and Glycosides are absent. Anthroquinone is present in heated tuber extracts, while Flavonoids, Saponins, Phenol, Phylobataning, Alkaloids, Tannins, and Glycosides are absent. Phenol, Tannins, and Glycosides are present in the cold extracts, but Flavonoids, Saponins, Anthroquinone, Phylobataning, and Alkaloids are absent. The presence of Anthroquinone, Phenol, Glycosides and the absence of Flavonoids, Saponins, Phylobataning, Alkaloids, and Tannins can be seen in hot back extracts, but the absence of Saponins, Phylobataning, Alkaloids, and Tannins can be seen in cold back extracts. In table 2 and table 3, the Phytochemical analysis of the fermented juice revealed the presence of only alkaloid while the fermented flour revealed the presence of alkaloid, flavonoid, tannin and phenol respectively.

Table 1. Phytochemical composition of Ipomoea batatas L.

Phytochemical Components	HE (leaf)	CE (leaf)	HE (stem)	CE (stem)	HE (tuber)	CE (tuber)	HE (bark)	CE (bark)
Flavonoids	+	-	+	+	-	-	-	+
Saponins	-	+	-	-	-	-	-	-
Anthraquinone	-	+	-	+	+	-	+	+
Phenol	+	-	+	+	-	+	+	+
Phylobataning	-	-	-	-	-	-	-	-
Alkaloids	-	-	-	-	-	-	-	-
Tannins	-	+	-	+	-	+	-	+

Glycosides	+	+	+	-	-	+	+	-

CE= Cold Extract, HE= Hot Extract, + = positive, - = negative

Table 2. Qualitative phytochemical screening of Fermented OFSP

Parameter	Fermented SP Juice
Saponin	-
Tannin	-
Flavonoid	-
Phenols	-
Steroids	-
Triterpenoid	-
Resin	-
Cardiac glycoside	-
Alkaloid	+
Terpenoid	-

Table 3. Quantitative phytochemicals

Parameter	Fermented SP flour mg/100g
Phenols	0.236
Alkaloid	0.246
Flavonoid	1.444
Tannin	0.286

The antibacterial capabilities of the cold extract of Ipomoea batatas L. (OFSP) tuber against the test organisms are shown in Table 4, which reveals that the organisms were sensitive to varied concentrations of cold extracts of Ipomoea batatas L. (OFSP) tuber. The results also showed that higher concentrations resulted in larger inhibition zones. At concentrations of 900 mg/ml and 450 mg/ml, *Staphylococcus aureus* was sensitive with a 20mm inhibitory zone. At dosages of 900 mg/ml and 450 mg/ml, *Escherichia coli* was sensitive with 35mm and 30mm zones of inhibition, respectively, and *Streptococcus pyogenes* was sensitive with a 24 mm zone of inhibition.

Table 4. Minimum Inhibitory Concentration (MIC) of Cold Extracts of *Ipomoea batatas L.* Tuber.

Isolates	Mean zone diameter of inhibition (mm)					
S. aureus	20	20	8	8	8	8
E. coli	35	30	8	8	8	8
S. pyogenes	24	8	8	8	8	8

Extract conc. In mg/ml	900	450	225	112.5	56.25	28.13

The antibacterial activity of a hot extract of *Ipomoea batatas L.* bark against *Serratia marcescens* is shown in Table 5. At various doses, the mean zone diameter of inhibition for Serratia *marcescens* on the extract ranged from 14 to 26 mm.

Table 5. Minimum Inhibitory Concentration (MIC)of Hot Extract of *Ipomoea batatas L.* Bark.

Isolates	Mean zone diameter of inhibition (mm)					
S. marcescens	26	16	16	15	14	14
Extract conc. In mg/ml	500	250	125	62.5	31.25	15.63

For Serratia marcescens, Table 6 provides the Minimum Inhibitory Concentrations (MIC) for a hot extract of Ipomoea batatas L. (OFSP) bark. Serratia marcescens is inhibited at a concentration of 500 mg/ml, hence the MIC is 500 mg/ml.

Table 6. Minimum Inhibitory Concentrations (MIC) for Hot Extract of *Ipomoea batatas L.* Bark.

	Extract conc. in mg/ml					
Isolates	500	250	125	62.5	31.25	15.63
S. marcescens	+	-	-	-	-	-

Keys: + = Sensitivity, **-** = Resistant

Table 7 demonstrates the Minimum Bactericidal Concentration (MBC) for Staphylococcus aureus in a cold extract of Ipomoea batatas L. (OFSP) tuber. At doses of 900 mg/ml and 450 mg/ml, Staphylococcus aureus is destroyed, making 450 mg/ml the MBC.

Table 7 shows Minimum Inhibitory Concentrations (MIC) of cold extracts of *Ipomoea batatas L.* (OFSP) for *Staphylococcus aureus*, *Escherichia coli* and *Streptococcus pyogenes*. *Escherichia coli* has no MIC. *Staphylococcus aureus* is inhibited at 900mg/ml and 450mg/ml, making 450mg/ml the MIC. *Streptococcus pyogenes* is inhibited at 900mg/ml only, making 900mg/ml the MIC.

Table 7. Minimum Inhibitory Concentrations (MIC) for Cold Extracts of *Ipomoea batatas L.* tuber.

	Extract conc.	in mg/ml				
Isolates	900	450	225	112.5	56.25	28.13
S. aureus	+++	++	+	+	-	-
E. coli	-	-	-	-	-	-
S. pyogenes	+	-	-	-	-	-

Table 8. Minimum Bactericidal Concentration (MBC) for Cold Extracts of *Ipomoea batatas L.* Tuber against *Staphylococcus aureus*.

	Extract conc. in mg/ml					
Isolates	900	450	225	112.5	56.25	28.13
S. aureus	+	+	-	-	-	-

Keys: + = Sensitivity, - = Resistant

Eighteen (18) out of twenty (20) people with high blood pressure and abnormal blood sugar levels reported significant improvements in their blood pressure and blood sugar levels in one region. Figure 3 shows the results as a pie chart. Only 10% of the participants reported no improvement, whereas 90% indicated great improvement.

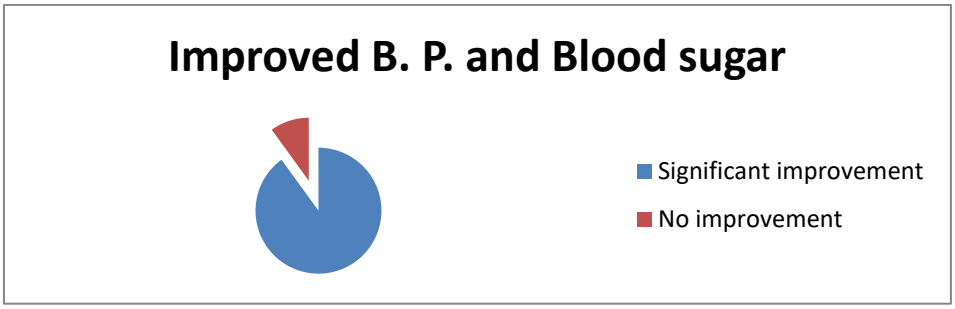

Figure 3. Pie Chart showing results for Improved Blood Pressure and Blood Sugar Levels of Individuals

6. Discussion

Cold extracts of fresh Ipomoea batatas L. contain saponins, flavonoids, anthraquinones, tannins, glycosides, and phenols. Flavonoids, anthraquinones, phenols, and glycosides are found in the hot extracts, whereas the fermented juice shows only the presence of alkaloid which was completely absent in non-fermented extract. [1] reported the presence of tannins, alkaloids, glycosides, saponins, flavonoids, and phenols in their research which is closely related to the phytochemicals observed in the fermented flour; alkaloid, flavonoid, tannins and phenol. Phytochemicals are secondary plant metabolites that are responsible for a wide range of plant extract bioactivity. Antioxidant, anti-inflammatory, antibacterial, immunomodulatory, and anti-sickling properties have been discovered in them. The existence of such metabolites is undoubtedly indicative of the plant extracts' therapeutic potential. Saponin has been demonstrated to have anti-hyper cholesterol, anti-hypertensive, and cardiac depressive actions.

The presence of tannins, as indicated in the results, indicates that this plant can act as an antidiarrheic and antihaemorrhagic agent. Antibacterial, anti-inflammatory, anti-allergic, and antiviral antineoplastic action has been demonstrated for flavonoids. Many of these purported effects have been attributed to their recognized antioxidant, free radical scavenger, and metal chelator properties. Glycosides may be important in the transduction of intracellular signals mediated by neurotransmitters, hormones, and neuromodulators receptors, which are activated by biological enzymes through hydrolysis, which separates the sugar component. These compounds can act on a variety of intracellular targets once triggered. After 5 days of consuming the *Ipomoea batatas L.* tuber, 18 of the 20 people with low blood sugar levels stated that their blood sugar levels had normalized. Blood pressures in patients with high B.P. were also said to have normalized. Cold

extracts of *Ipomoea batatas L.* tuber, is sensitive against *Staphylococcus aureus, Esherichia coli* and *Streptococcus pyogenes*while hot extracts of Ipomoea batatas L. bark, is sensitive against *Serretiamarcesens*which shows that the medicinal property of the tuber is higher in the uncooked product than when exposing it to heat.

7. Conclusion

Ipomoea batatas L. contains phytochemicals, according to this study. The plant has antibacterial activities against *Staphylococcus aureus, Escherichia coli, Streptococcus pyogenes and Serretiamarcesens*, indicating that it can be utilized as an alternative medicine to fight antibacterial resistant. The phytochemicals in the fermented product is different from that of the fresh product. In addition, *Ipomoea batatas L.* has been shown to be useful in the treatment of high blood pressure and blood sugar levels.

Recommendations.

- The Federal Ministry of Health and Agriculture should perform additional research on orange- fleshed Sweet potato plants to fully understand their potential, as there is currently very little literature accessible.
- OFSP should be consumed uncooked to be effective as an alternative medicine.
- Native plant research should be done more frequently in general to enhance knowledge of the Benefits and efficacy of traditional medicine.

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