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Physicochemical Properties, Phytochemical Contents, Antibacterial and Antioxidant Potentials of a Formulated Polyherbal Syrup

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Abstract

Herbal formulation refers to the process of preparing a medicinal product using one or more plant materials to achieve a desired therapeutic effect. It involves combining different herbs in specific proportions to enhance their overall effectiveness, stability, and safety. It can be in the form of syrups, tablets, capsules, ointments, teas, or powders. This study is aimed at developing a polyherbal syrup (PHS) from *Allium cepa*, *Allium sativum*, *Zingiber officinale*, *Moringa oleifera*, and *Vernonia amygdalina*. The PHS was evaluated for its physicochemical properties, phytochemical contents, antibacterial, and antioxidant properties. Carbohydrates, proteins, alkaloids, flavonoids, tannins, saponins, and phenolic compounds were detected as some of the phytochemicals in PHS; with phenolic compounds being the highest in quantity, phenols (411.67 mg/g), followed by flavonoids (135.44 mg/g), saponins (91.14 mg/g), tannins (24.48 mg/g), alkaloids (13.23 mg/g), and cardiac glycosides (10.36 mg/g). The syrup (100% v/v) exhibited significant inhibitory activity against MDR Bacillus subtilis (ATCC 6051) with an MIC and MBC of 100% in comparison with Streptomycin (30 µg/mL) Antioxidant capacity, assessed through DPPH, FRAP, and TAC assays, demonstrated significant free radical scavenging and reducing power of PHS, confirming its antioxidant efficacy. This potential can be harnessed for pharmacological and pharmaceutical utilization, which will boost the potency of the syrup as a therapeutic agent for the treatment and management of oxidative stress and diseases caused by Gram-positive MDR bacteria isolates. However, further investigations are required.

Keywords: Polyherbal formulation, Antibacterial, Antioxidant, Syrup, Phytochemicals, Physicochemical properties.

Introduction

Over the years, many different diseases have been treated with herbal remedies. Due to the enormous variety of functionally relevant secondary metabolites produced by microbial and plant Species. Natural products and related

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structures are important sources of novel pharmaceuticals [1]. Traditional herbal medicine refers to the use of plants or plant material, whether in their raw or processed form, to treat injury or disease. Herbal formulations are dosage forms made up of one or more fresh or processed herbs in precise amounts to provide specific nutritional, aesthetic, and health benefits. They can be used to treat illness, alleviate symptoms, or change an animal's or human's structure or physiology [2, 3]. There may be interaction effects when natural herbs and herbal ingredients are used in particular combinations [4]. Our knowledge of the various medicinal plants has led to the idea of polyherbalism, or polyherbal formulations. Formulations containing two or more herbs are known as polyherbal formulations. Despite the fact that active phytoconstituents in single herbal formulations are well known, they are frequently present in negligible concentrations and occasionally not enough to produce the desired therapeutic effect [5]. Scientific research suggests that combining plants with different potencies may produce a greater effect than using them separately or adding up their individual effects. Because of this, when two herbs work well together, they synergize and may have pharmacokinetic or pharmacodynamic effects. The appeal of polyherbal formulations is due to their remarkable effectiveness in treating a variety of disorders. They have fewer side effects, are more affordable, environmentally friendly, and widely available [5]. They are also safe at high doses and effective at low doses. Therefore, this study aims at evaluating a polyherbal syrup made made from *Allium cepa, Allium sativum, Zingiber officinale, Moringa oleifera,* and *Vernonia amygdalina* for its physicochemical properties, phytochemical contents, antibacterial and antioxidant potentials.

Materials and Methods

Sample collection

The bulb of *Allium cepa* (onion), the clove of *Allium sativum* (garlic) and the rhizome of *Zingiber officinale* (ginger) were purchased from a local market, while the leaves of *Moringa oleifera* (drum stick) and *Vernonia amygdalina* (bitter leaf) were collected from Anyigba in Dekina Local Government Area of Kogi State, Nigeria. The samples were then transported to the laboratory in a polythene bag. Prior to analyses, the samples were identified by Mr. Ayegba, O. Sule at the Herbarium section, Botany Unit, Kogi State University, Anyigba, Nigeria. The specimen voucher numbers are PT – 017 for *Allium cepa*, PT – 018 for *Allium sativum*, PT – 0318 for *Zingiber officinale*, PT – 0222 for *Moringa oleifera*, and PT – 0307 for *Vernonia amygdalina*.

Preparation of onion (*Allium cepa*) sample

The onion bulbs were cleaned and all unwanted dirt washed away by running a faucet. Using a knife, the clean onions were peeled by hand and then cut into 5 mm-thick slices. Before being used, the sliced onions were kept fresh and dry in

food-grade plastic containers that were sealed tightly.

Preparation of garlic (*Allium sativum*) sample

To get rid of dirt, the garlic cloves were cleaned. Using a knife, the cleaned garlic was chopped into smaller pieces. After being air-dried, the sliced garlic was kept until further examination in an airtight polythene bag.

Preparation of ginger (*Zingiber officinale*) sample

Ginger rhizomes were washed to remove dirt. With a knife, the clean gingers were cut into smaller pieces. The sliced gingers were air-dried before being stored in an airtight polythene bag until further examination.

Preparation of drumstick (*Moringa oleifera*) and bitter leaf (*Vernonia amygdalina*) samples

Leaves of Moringa and Bitter Leaf leaves were washed to remove dirt. The cleaned leaves were kept fresh in a polythene bag until they were analyzed.

Preparation of Extracts

i. Twenty gram (20 g) of each pulverized samples (onion, garlic and ginger) was extracted with 100 mL of distilled water by decoction method for a period of 3 hours at 40 °C. Each resulting mixture was filtered, and the filtrate collected and stored in separate containers

ii. Fifty gram each of the fresh leaves of Moringa and bitter leaf were juiced by hand squeezing. Each resulting juice mixture was collected separately by filtration and stored in the refrigerator for further analysis.

Formulations of Polyherbal Syrup (PHS)

The polyherbal syrup was prepared and formulated using extracts of *Vernonia amygdalina* (bitter leaf), *Moringa oleifera* (drumstick), *Allium cepa* (onion), *Allium sativum* (garlic), and *Zingiber officinale* (ginger), as presented in **Table 1**.

Table 1: Formulation of Polyherbal Syrup (PHS)

Ingredients	**Formulation (mL)**
	PHS
Allium cepa (Onion bulbs)	10
Allium sativum (Garlic cloves)	10
Zingiber officinale (Ginger rhizome)	10
Moringa oleifera (Moringa leaves)	10
Vernonia amygdalina (Bitter leaves)	10
Honey	50

Physicochemical Properties of the Polyherbal Syrup (PHS)

The polyherbal syrup was evaluated for various physicochemical parameters such as physical

appearance (appearance, colour, odour and taste), pH, density, viscosity and specific gravity.

Physical evaluation

The appearance, colour, odour and taste of the polyherbal syrup was evaluated.

Chemical evaluation

i. Determination of specific gravity at room temperature (25 ℃) Specific gravity of PHS was determined using **equation 1**, where W1 is the weight of the empty beaker, W2 and W3 represent the weights of the beaker containing the syrup and the beaker containing an equal amount of water, respectively. The following formula was used to calculate specific gravity;

$$Specific\ gravity = \frac{weight\ of\ syrup\ (W2 - W1)}{weight\ of\ water\ (W3 - W1)} \quad (1)$$

ii. Determination of density

The density of PHS was determined using **equation 2**. The difference in weight between the syrup-filled bottle (Wx) and empty bottle (Wy) was taken as weight of syrup (Ws), and density was calculated using the provided formula;

$$Density\ of\ syrup = \frac{weight\ of\ syrup\ (Ws)}{Volume\ of\ syrup\ (Vs)} \quad (2)$$

iii. Determination of viscosity

The viscosity of the syrup was determined using Ostwald viscometer (CL2370-05-10), and the formula stated below was used in the calculation;

$$Viscosity\ of\ syrup = Vw\ x\ \frac{Ds\ x\ ts}{Dw\ x\ tw} \quad (3)$$

Vw = Viscosity of water

Ds = density of syrup

Dw = density of water

ts = run off time for sample

tw = run off time for water

iv. Determination of pH

The pH of the syrup was determined using a digital pH meter. Average of three replicate readings was taken.

Storage study of polyherbal syrup

To preserve the polyherbal syrup, it was refrigerated 4±1°C. Storage studies were conducted every 15 days (i.e., 0,15,30,45,60,75,90 days). The polyherbal syrup was assessed for physico-chemical parameters (Acidity, pH, and Viscosity) during these intervals [6].

Phytochemical Screening

Phytochemical screening of the individual extract and polyherbal syrup (PHS) was performed using standard procedures [7–13].

Antibacterial Assay

Collection and identification of test organisms

The antibacterial potential of PHS was evaluated against multi-drug resistant bacteria isolates (*Staphylococcus aureus* (ATCC 25923), *Bacillus subtilis* (ATCC 6051), *Klebsiella pneumoniae* (ATCC 15380), *Serratia marcescens* (ATCC 274), *Micrococcus luteus* (NCTC 196) *and Pseudomonas aeruginosa* (NCTC 950)). The bacterial isolates were obtained from the Department of Microbiology, Obafemi Awolowo University, Ile-Ife, Nigeria.

Antibacterial screening of the polyherbal syrup

The agar-well diffusion method was used to determine the antibacterial activity of the polyherbal syrup (PHS) [14]. Before being used, the bacterial isolates were standardized (0.5 McFarland standard) and cultured for 18 hours in nutrient broth. Afterwards, 0.1 mL of the standardized test isolates were distributed onto sterile Mueller-Hilton agar (MHA) plates that had solidified. To eliminate any potential agar contamination, 19 g of MHA powder was prepared in 500 mL of distilled water and sterilized in an autoclave for 15 minutes at 120 °C. To prevent unintentional contamination, the petri dishes, wire loop, cork-borer, and other tools required for the task were all sterilized. The MHA plates were perforated with wells using a sterile 6 mm cork-borer. 100 % (v/v) of the PHS at a two-fold serial dilution was added to the wells. It was managed to stop the solution from overflowing onto the medium's surface. Before incubating the plates for a full day at 37 °C, they were left to stand on the lab bench for two hours to allow the mixture to properly enter the medium. After the incubation period, the antibacterial activity of the syrup was observed by looking at the different zones of inhibition and measuring their diameters with a vernier caliper. Distilled sterile water was utilized as the negative control and 30 µg/mL of streptomycin as the positive control.

Determination of Minimum Inhibitory Concentration (MIC)

A standard technique was used to estimate the MIC of the polyherbal syrup (PHS). Loops from each test organism were inserted into test tubes containing nutritional broth, and 100 % (v/v) of the syrup was poured into each tube. It was decided to use the 0.5 McFarland turbidity standard. After being transferred into sterile Petri dishes, the medium was left to solidify. After being incubated for 72 hours at 37 °C, the plates were checked to see if any growth had occurred. The minimum inhibitory concentration, or MIC, was determined [15].

Determination of minimum bactericidal concentration (MBC)

A modified method was utilized to determine the minimum bactericidal concentration (MBC). Samples from the plates in which the MIC test

showed no discernible growth were taken, and they were subcultured on brand-new nutrient agar plates that were kept at 37 °C for a full day. On a fresh batch of sterile agar plates, the concentration of PHS that did not exhibit any growth was taken as MBC [16].

Free Radical Scavenging Analysis

DPPH scavenging assay

The free radical scavenging activity of the polyherbal syrup (PHS) using 1,1-diphenyl-2-picrylhydrazyl (DPPH) was determined by the methods of Adesegun *et al*. [17] and Rotimi *et al*. [36]. Different concentrations (25, 50, 100, 200, 400, 800, 1600, and 3200 µg/mL) of the syrup was prepared in methanol. 0.032 mL of the syrup was weighed and dissolved in 10 mL of methanol. The samples of the different concentrations were mixed with 2 mL of 0.15 mM DPPH. Each mixture was shaken vigorously and allowed to stand in the dark at room temperature for 30 minutes, and the absorbance was measured spectrophotometrically (using Shimadzu UV-1700 PharmaSpec) at 517 nm. Ascorbic acid (Vitamin C) at various concentrations (25, 50, 100, 200, 400, 800, 1600, 3200 µg/mL) was used as standard. Radical scavenging activity was expressed as the inhibition of free radical by DPPH in percentage (I %) and was calculated using equation 4.

$$I\ (\%) = \frac{A_{blank} - A_{sample}}{A_{blank}}\ x\ 100 \quad (4)$$

Where; A_{blank} = Absorbance of blank

A_{sample} = Absorbance of sample

Total antioxidant capacity (TAC) scavenging assay

The total antioxidant capacity of the sample (PHS) was determined spectrophotometrically using the phosphomolybdenum method, as described by Prieto *et al*. [18] and Rotimi *et al*. [36]. 1 mL of sample (0.5 mg/mL) was mixed with 3 mL of reagent solution (0.6 M H_2SO_4, 28 mM sodium phosphate, and 4 mL of ammonium molybdate). Only 4 mL of reagent solution was present in the blank solution. The mixtures were incubated for 150 minutes at 95 °C. At 695 nm, absorbance was measured after the mixture had cooled to room temperature. Tannic acid equivalent (TAE) was used to calculate total antioxidant capacity (TAC).

FRAP scavenging assay

According to the standard method, the ferric-reducing antioxidant potential (FRAP) of the syrup was calculated. The reducing power of PHS (an antioxidant) was used in the assay. A potential antioxidant converts ferric ion (Fe^{3+}) to ferrous ion (Fe^{2+}). The latter results in the formation of a blue complex (Fe^{2+}/TPTZ). The FRAP reagent was made by combining 50 mL of acetate buffer (0.3 M, pH 3.6), 5 mL of 10 mM tripyridyltriazine (TPTZ) solution in HCl (40 mM), and 5 mL of 20 mM ferric chloride ($FeCl_3$) solution at 10:1:1 (v/v/v). To 100 L of syrup, 2 mL of freshly prepared FRAP reagent was added. The absorbance was measured at 593 nm after 30 minutes at 25 ℃. The standard curve was

constructed using different concentrations of vitamin C. The result was expressed as vitamin C equivalent in μmol/mL of syrup [19].

Results and Discussion

Tables 2-10 reveal the physicochemical properties, phytochemical composition (**Figure 1**), Antibacterial activity, Antioxidant potential (**Figures 2-7**) and Lethal dose (LD_{50}) of the polyherbal syrup (PHS).

Table 2: Physicochemical properties of the PHS

Parameters	PHF syrup
Density (g/cm^3)	1.50
Specific gravity	1.2931
Viscosity (cp)	12.28
pH Determination	
a) pH paper	Acidic
b) pH meter	3.74
Organoleptic Characters	
1) Colour	Greenish-brown
2) Odour	Characteristic smell
3) Taste	Slightly sweet
4) Appearance	Turbid

Table 3: Physicochemical change in the polyherbal syrup (PHS) during storage study

Days	Acidity	pH	Viscosity (cp)
0	1.25	3.74	12.28
15	1.25	3.74	12.28
30	1.26	3.79	12.28
45	1.27	3.81	12.28
60	1.28	3.83	12.28
75	1.28	3.83	12.28
90	1.29	3.84	12.28

It used to be common practice for many pharmaceutical manufacturing companies to assess the stability of pharmaceutical preparations by keeping track of them for a year or longer, which was roughly equal to how long they would typically be kept in stock and used. Nowadays, the majority of pharmaceutical businesses assess the stability of all kinds of formulations using

accelerated stability studies. This stability study will advance the science of phytopharmaceuticals significantly. **Table 2** displays the results of the physicochemical properties of PHS. The results agree with the findings of Naknean *et al*. [20]. **Table 3** displays the changes that occurred while the herbal syrup was refrigerated (4±1 °C). The polyherbal syrup had a slight increase in acidity from 1.25 (day 0) to 1.29 (90 days) during storage. The slight increase could result from the breakdown of some organic substances (secondary metabolites) in the syrup [20]. However, the results of the physicochemical properties obtained have no negative impact on the syrup. The polyherbal syrup maybe consumed for up to 90 days, according to the results of the findings.

Table 4: Concentration of individual extracts that contributed to the formulation of PHS

Phytochemicals	**Concentration of Syrup (mg/g)**				
	BI	**GA**	**MO**	**GI**	**ON**
Alkaloids	10.95 ± 0.014	6.48 ± 0.007	11.77 ± 0.021	13.43 ± 0.014	12.85 ± 0.014
Flavonoids	97.27 ± 0.078	34.28 ± 0.078	139.45 ± 0.163	92.84 ± 0.078	165.56 ± 0.163
Total Phenols	323.17 ± 0.233	163.34 ± 0.474	312.17 ± 0.233	374.67 ± 0.007	541.00 ± 0.467
Tannins	16.73 ± 0.041	14.68 ± 0.007	29.46 ± 0.021	17.03 ± 0.042	26.14 ± 0.014
Saponins	59.44 ± 0.283	50.74 ± 0.141	80.14 ± 0.141	84.54 ± 0.141	87.24 ± 0.283
Cardiac glycosides	9.57 ± 0.014	4.59 ± 0.014	12.64 ± 0.007	11.70 ± 0.014	9.58 ± 0.283

Mean ± SE of three replicates

BI = Bitter leaf; GA = Garlic; MO = Moringa; GI = Ginger and ON = Onion

Table 5: Phytoconstituents of the Polyherbal Syrup (PHS)

Phytochemicals	**Inference**	**Concentration (mg/g)**
Alkaloids	+	13.23 ± 0.014
Flavonoids	+++	135.44 ± 0.156
Total Phenols	+++	411.67 ± 0.474
Tannins	+	24.48 ± 0.021
Saponins	++	91.14 ± 0.141
Cardiac glycosides	+	10.36 ± 0.007

Values are present as mean ± SE.

+ = Slightly present; ++ = Moderately present; +++ = Highly present

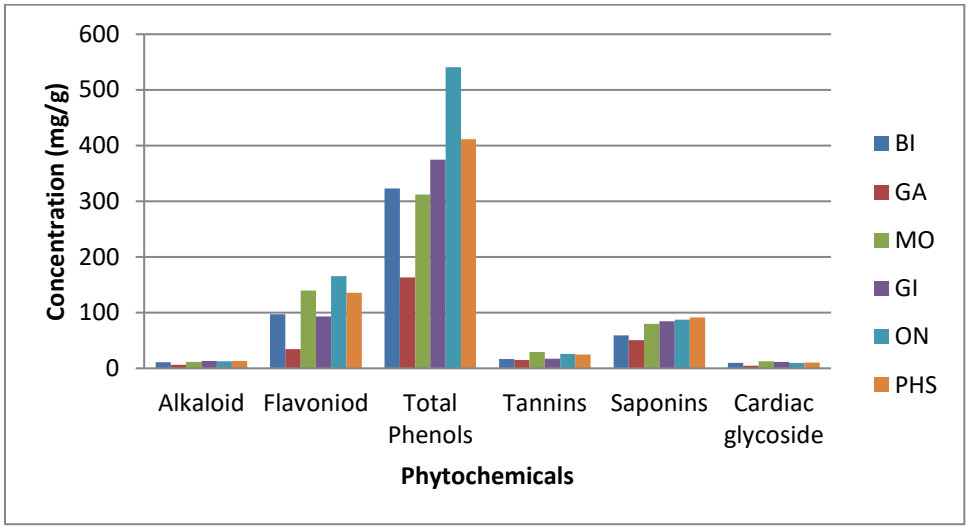


Figure 1: Synergetic evaluation of the phytochemicals present in the formulated syrups

Alkaloids, flavonoids, phenolic compounds, tannins, saponins, and cardiac glycosides were identified as phytoconstituents in the formulated syrups (**Tables 4-5** and **Figure 1**). The ability of phenolic compounds to effectively scavenge oxidizing molecules, such as singlet oxygen and various free radicals linked to several diseases, is well known [21, 36]. The potential activity of phenolic compounds against a variety of human viruses is well known; phenolic compounds also have immunomodulatory and anti-inflammatory properties [22]. According to studies, flavonoids have anti-oxidant and mucosal-protective properties [23, 24, 37]. Herbs high in flavonoids are used as functional foods frequently to treat cardiovascular diseases. By strengthening the body's overall antioxidant defense system, flavonoids protect against these diseases [25]. However, saponins play a significant part in lowering blood cholesterol levels by forming complexes with bile acid and cholesterol that stop them from being absorbed through the small intestine, lowering blood and liver cholesterol levels [26]. Saponins also function as antioxidants because they stop DNA deterioration and lessen colon damage. By halting the growth of cancer cells, they reduce the risk of human cancer and strengthen our immune system [27]. Additionally, it has been suggested that the presence of tannins and glycosides may have antibacterial and antifungal properties [28, 29]. Alkaloid compounds are also fundamentally important medical treatments recognized for their bactericidal, antispasmodic, and analgesic properties [30]. Alkaloids have also been used as anti-puretics, topical anesthetics in ophthalmology, and stimulants of the central nervous system. However, since phenolic compounds are biological antioxidants, a highly significant presence of these phenolics in the individual extracts, as well as, PHS is an indication of the highly therapeutic potential for

the management of cardiovascular diseases and oxidative stress. The polyherbal syrup's therapeutic versatility as a potential antioxidant, antibiotic, anticancer, and anti-diabetic drug is therefore indicated by the presence of these phytochemicals in the syrup. However, additional research is necessary to support the aforementioned claim.

Table 6: Antibacterial activity of the polyherbal syrup (PHS)

Sensitivity Test		
Bacteria	**PHS 100 % (v/v)**	**Streptomycin (30 µg/mL)**
	Zone of inhibition (mm)	Zone of inhibition (mm)
Staphylococcus aureus (ATCC 25923)*	12.33 ± 0.577	13.00 ± 0.00
Bacillus subtilis (ATCC 6051)*	18.33 ± 0.577	NA
Micrococcus luteus (NCTC 196)*	14.67 ± 1.155	NA
Pseudomonas aureginosa (NCTC 950)	NA	NA
Klebsiella pneumoniae (ATCC 15380)	NA	NA
Serratia marcescens (ATCC 274)	NA	NA

The data are mean value ± standard deviation of three replicates

* Gram-positive bacteria NA = No Activity

Table 7: MIC and MBC of PHS and standard antibiotic against bacteria isolates

Bacteria	**Polyherbal syrup (v/v)**		**Streptomycin (µg/mL)**	
	MIC	MBC	MIC	MBC
Bacillus subtilis (ATCC 6051)*	100 %	100 %	NA	NA
Staphylococcus aureus (ATCC 25923)*	100 %	NA	15	30
Micrococcus luteus (NCTC 196)*	100 %	NA	NA	NA

* Gram-positive bacteria NA = No Activity

All of the bacterial isolates tested were multidrug-resistant, according to the antibacterial susceptibility profile (**Table 6**). The syrup, exhibit activity against all Gram-positive multidrug-resistant (MDR) isolates, with a zone of inhibition ranging from 12.33 to 18.33 mm, according to the findings of this study. However, no activity was observed against gram-negative isolates. Furthermore, the MIC and MBC results (**Table 7**) revealed 100 percent activity against all Gram-positive bacteria isolates used in the study, as well as 100 percent bactericidal activity against *Bacillus subtilis* (ATCC 6051). The antibacterial activity of the syrup could be attributed to the presence of secondary metabolites that were earlier detected in PHS. The results revealed that, the syrup exhibited higher activity against MDR

isolates when compared with the standard drug (streptomycin).

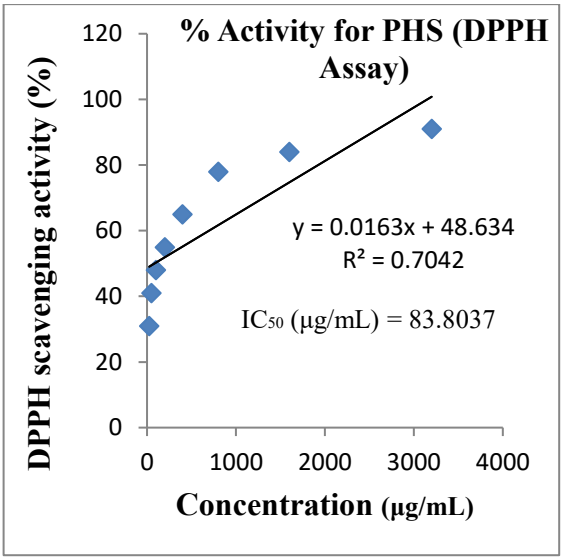


Figure 2: DPPH Antioxidant standard calibration curve for the Polyherbal syrup

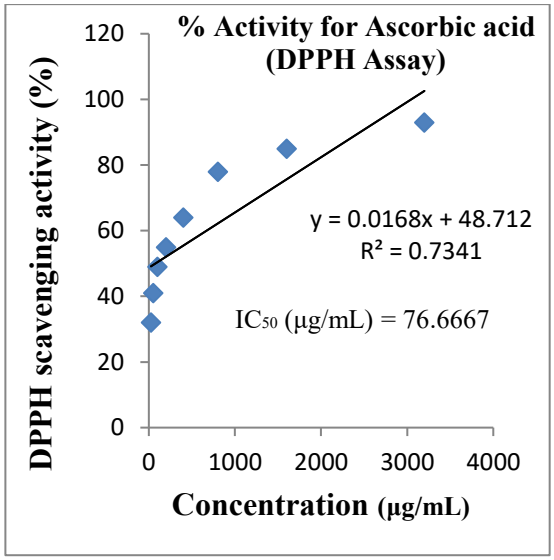


Figure 3: DPPH Antioxidant Standard calibration curve for the standard

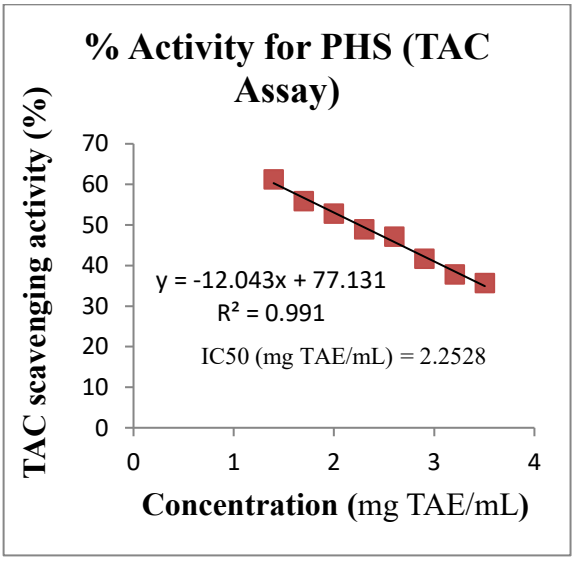


Figure 4: TAC Antioxidant calibration curve for the Polyherbal syrup

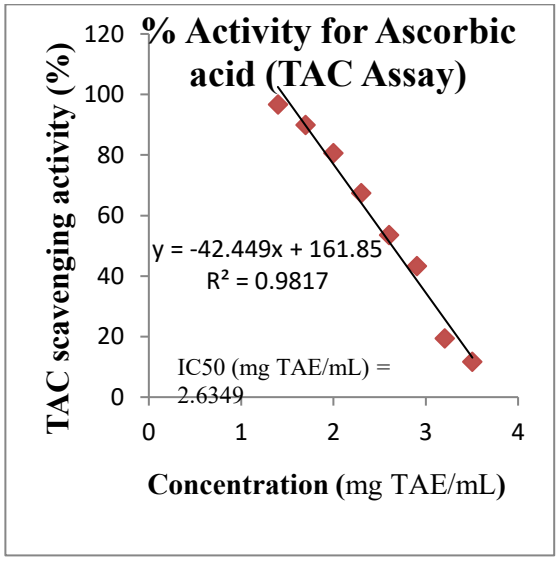


Figure 5: TAC Antioxidant calibration curve for the standard

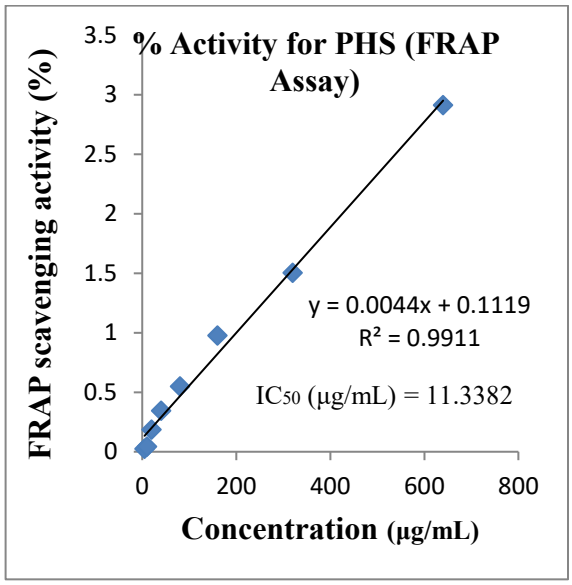


Figure 6: FRAP Antioxidant calibration curve for the Polyherbal Syrup

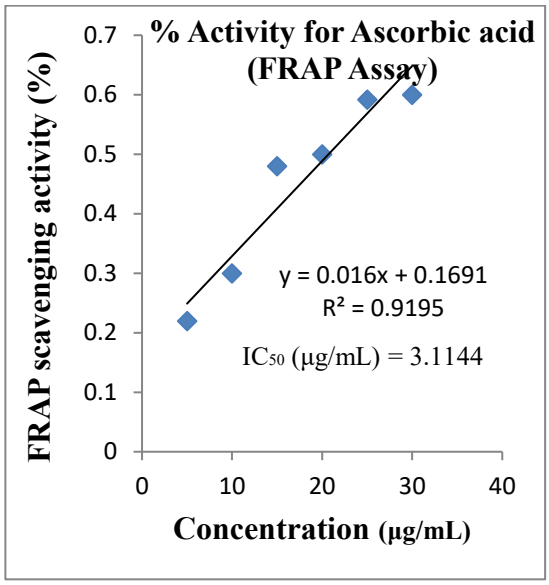


Figure 7: FRAP Antioxidant calibration curve for the standard

Table 8: Summary of the Free radical scavenging activity of PHS

Antioxidant assay	**% Activity of sample (PHS)**	**% Activity of standard (Ascorbic acid)**
DPPH (µg/mL)	83.8037	76.6667
FRAP (µmol/mL)	11.3382	3.1144
TAC (mg TAE/mL)	2.2528	2.6349
R-values	**Sample (PHS)**	**Ascorbic acid`**
DPPH	0.7042	0.7341
FRAP	0.9911	0.9195
TAC	0.9910	0.9817

The search for naturally occurring antioxidants has increased significantly in order to replace synthetic antioxidants, which are being phased out due to their toxicity and carcinogenicity. It is well known that phenolic compounds directly contribute to the antioxidant activity of plant extracts [31, 38].

The phosphomolybdenum method of Total Antioxidant Capacity (TAC) assay is based on the reduction of Mo^{6+} to Mo^{5+} by the sample analytes (PHS and Vitamin C) and the subsequent formation of a green phosphate/Mo^{5+} complex. TAC assays are commonly used to detect antioxidants such as carotenoids, phenolic compounds, ascorbic acid, and –tocopherol [18]. The Antioxidant capacity testing (**Figures 4-5**) revealed that the syrup contained 2.2528 mg $TAEg^{-1}$, which was significantly higher than the standard (2.6349 mg TAEg-1).

The DPPH radical scavenging assay is the most commonly used method for determining the antioxidant activity of plant material [32]. The DPPH radical scavenging activity was expressed as the IC_{50}, which is the concentration of the test samples required to scavenge 50 % of the DPPH free radicals. The greater the DPPH radical scavenging activity, the lower the IC_{50} value. The IC_{50} of the syrup (83.8037 g/mL) compared favorably with the standard (76.6667 g/mL) (**Figures 2-3**). The high DPPH scavenging potential of the syrup can be attributed to its high content of phenolic compounds, particularly flavonoids [33]. Nonetheless, findings from earlier research has shown that formulations made of polyherbal ingredients have a comparatively high potential as antioxidants [5, 34-35].

Also in the FRAP assay, the sample tested, reduced ferric ion (Fe^{3+}) to ferrous ion (Fe^{2+}), leading to the formation of a blue complex (Fe^{2+}/TPTZ) [19]. The IC_{50} of the syrup (11.3382 µmol/mL) was compared favorably to the standard (3.1144 µmol/mL) as shown in **Figures 6–7**. This suggests that the amount of total phenolic compounds in the syrup was comparatively correlated with its antioxidant potential and free radical scavenging activity against TAC, DPPH, and FRAP free radicals.

4.0 Conclusion

The findings from this study revealed that the polyherbal syrup made from *Vernonia amygdalina, Moringa oleifera, Zingiber officinale, Allium cepa,* and *Allium sativum* revealed a rich presence of a variety of secondary metabolites, such as; phenolics, saponins and alkaloids. However, the syrup may help with the treatment of oxidative stress and cardiovascular diseases because of the strong presence of phenolic compounds, which are known to be good antioxidants. The results of the physicochemical properties obtained have no negative impact on the syrup. The polyherbal syrup maybe consumed for up to 90 days, according to the results of the findings. The existence of these phytochemicals in the polyherbal syrup thus suggests the syrup's therapeutic versatility as a possible antioxidant and antibacterial drug. To determine whether the syrup is a possible drug, more research is necessary.

Conflicts of Interest

There are no conflicts of interest to declare. All authors declared that they have participated in the study and concur with the submission and subsequent revisions of the manuscript.

Declaration of Interest

We hereby declare that the disclosed information is correct and that no other situation of real, potential or apparent conflict of interest is known to us. We undertake to inform you of any change in the circumstances, including if any issue arises in the course of review. Thanks

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