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Phytochemical analysis and medicinal uses of *Hibiscus sabdariffa*.

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Abstract

The phytochemical analyses, nutrient value and economic importance of *Hibiscus sabdariffa* commonly known as Zobo plant was carried out. In Nigeria the plant is used to make a popular beverage known as Zobo drink. Investigations revealed that the plant is highly rich in vital minerals and nutrients such as Iron, copper, calcium, magnesium, manganese required for healthy growth in humans. The phytochemicals were extracted from the dried calyces of *Hibiscus sabdariffa* using solvent extraction method. The preliminary phytochemical analysis showed that there are some plant chemicals present in the extract such as alkaloids, tannins, saponins, glycosides, phenols and flavonoids and quantitative result revealed their presence as follows; Tannins (17.0%), saponins (0.96%), phenols (1.1%), glycosides (0.13%), alkaloids (2.14%) and flavonoids 20.08%). *Hibiscus sabdariffa* has medicinal benefits as it causes reduction in hypertension and cholesterol. The plant is economically important for proper metabolic process to be adequately maintained. It was discovered that the dietary constituents contributing to the protective effects of these plant materials are plant secondary metabolites in the form of phytochemicals, vitamins and minerals. Medicinal and aromatic plants contain biologically active chemical substances such as saponins, tannins, glycosides and other chemical compounds which have curative properties. This study suggests that plant derived medicines are relatively safer than synthetic alternative offering profound therapeutic benefits and more affordable treatment, hence, *Hibiscus sabdariffa* is readily available to provide such benefits.

Keywords: Hibiscus sabdariffa, Phytochemicals, Infusion, Zobo drink.

1. Introduction

Hibiscus sabdariffa is a species of hibiscus, native to the old world tropics, used for the production of bast fiber and as an infusion (herbal tea). The plant is an annual or perennial herb or woody-based sub-shrub, growing up to 2-2.5 m (7-8 ft) tall. The leaves are deeply 3-5 lobed, 8-15 cm long arranged alternatively on the stems [1]. The flowers are 8-10 cm in diameter, white to pale yellow with a dark red spot at the base of each petal and have a stout fleshy calyx at the base 1-2 cm wide, enlarging to 3-3.5 cm, fleshy and bright red as the fruit matures. It takes about 6 months to mature [2]. The plant is widely cultivated for its strong fibers and it is well known for its edibility and medicinal properties, though the calyx is the most frequently used portion of the plant, the leaves and seeds are often made into salads, curries and potherbs [3]. They are rich in vitamins, natural carbohydrate, protein, tannins, gums and other antioxidants including minerals [4]. The chemistry of the calyx revealed that per 100 g, it contained 49 calories, 84.5% water, 1.99 protein, 0.1 g fat, 12.3 g total carbohydrate, 2.3 g fiber, 1.2 g ash, 1.72 mg calcium, 57 mg phosphorus, 2.9 mg iron, 300 g vitamin A equivalent and 14mg ascorbic acid [1].

Hibiscus sadariffa has common names such as ‘Roses of anthea’ ‘African mallow’, ‘Roselle’, ‘Rose mallow’, ‘Indian sorrel’, ‘Flore de Jamaica’ and Jamaica tea [5]. *Hibiscus sabdariffa* is known as ‘Roselle’ in Australia, ‘Tengamoran’ in Asam, ‘Gongura’ in Hindi, ‘Krajeab’ in Thailand, ‘Bissap’ in Senegal, Guinea Bissau, Mali, Burkina Faso, Ghana, Benin, Niger, Congo and France. ‘Wonjo’ in Gambia, ‘Torosh’ in Iran, ‘Sorrel’ in Carribean, ‘Karkade’ in Egypt, ‘Asam Paya’ in Malaysia, ‘Luoshen Hua’ in Chinese, ‘Lamanda’ in Zambia and ‘Zobo’ in Nigeria [6]. The fruits are surrounded by enlarged fleshy calyces containing 22-34 seeds per capsule. The seeds are dark brown in colour, 4-6cm long and about 0.025 g in weight, grow up to 2 meters and leaves vary in shape and size [7]. There are more than 200 species in all over the world [2]. *Hibiscus sabdariffa* is cultivated for leaf, seed, fleshy calyx or fiber [8]. The plant is grown in all parts of the world; it is a native to India but was introduced to other parts of the world such as Central America, West Indies and Africa. It is highly cultivated and distributed in the northern part of Nigeria because of favourable

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climate ^[9]. *Hibiscus sabdariffa* is found in tropical and subtropical regions of the world, it is cultivated for its fiber with characteristics similar to those of hemp or jute which is used to make cloth, rope and in Polynesia, grass skirts ^[10]. *Hibiscus sabdariffa* plant parts such as seed, stem, leaves and calyces are harvested from late December to February. The harvest is timed according to ripeness of the seed. The fleshy calyces are harvested after the flower has dropped but before the seedpod has dried and opened. The more time the capsule remains on the plant after the seeds begin to ripe, the more susceptible the calyx is to sores, sun cracking and general deterioration in quality ^[1, 11]. *Hibiscus sabdariffa* 'Zobo' drink has a shelf of life normally 24 to 48 hours after which it begins to deteriorate. It is best preserved by refrigeration which will control the micro-organism reaction on the drink ^[12]. Due to the ubiquitous nature of micro-organisms, the level of contamination can be reduced if proceeded under standard hygienic conditions and at low temperatures to prevent the multiplication of pathogenic micro organisms that can cause infection to the consumers ^[13]. Delicate hibiscus flower requires special handling during and after preservation. The blossoms are fragile and cannot tolerate the pressure from conventional flower pressing. The use of desiccants and silica crystals helps wick away moisture from the petals while still protecting the shape and colour of the bossom of the plant ^[8].

2. Materials and Methods

2.1 Plant Collection

The samples of *Hibiscus sabdariffa* calyces were collected in February, 2013, at the meat market, Abakaliki in Ebonyi State of Nigeria. The plant was identified by Mr. Okereke, C. N of the Department of Applied Biology at Ebonyi State University, Abakaliki.

2.2 Extract Preparation

Reasonable quantity of the plant *Hibiscus sabdariffa* calyces were collected and after it identification, the leaves were thoroughly dried and smashed using mortal and piston. The dried powder samples were however used for the various analyses. The extraction of *Hibiscus sabdariffa* calyces was done using 20g of the grinded calyces sample in soxhlet

extractor with distilled water, ethanol, methanol, ethyl, acetate and petroleum ether at Project Development Institute (PDI), Enugu State, Nigeria.

2.3 Phytochemical Analysis

The water extract and other extracting reagents such as methanol, ethanol, ethyl acetate and petroleum ether on *Hibiscus sabdariffa* were subjected to preliminary phytochemical screening to identify the chemical constituents. Test for the presence of alkaloids, flavonoids, phenols, saponin, steroid, tannin, terpenoids, glycosides, phlobatannins was done using ^[14] method with some modifications. Quantitative determination of the phytochemical constituents of the plant was done using gravimetric method described by ^[14] with some modifications. The determination was carried out on alkaloid, flavonoid, phenols, saponins, tannins and glycosides. The percentage constituent was calculated thus;

$$\frac{100 \times AU \times C \times VF}{W \times AS \times VA} = \% \text{ constituent}$$

Where:

W	=	Weight of sample analyzed
AU	=	Absorbance of test sample
AS	=	Absorbance or concentration of standard solution
VF	=	Total volume of filtrate analyzed
VA	=	Volume of filtrate analyzed
C	=	Total volume of extract.

2.4 Preparation of 'Zobo' Drink from *Hibiscus Sabdariffa*

The 'Zobo' drink is prepared by boiling the dried calyces of *Hibiscus sabdariffa* in water for about 10-15 minutes from which the pigment or flavor embedded is extracted. After extracting the filtrate, it may be taken as hot tea or allowed to cool and packaged in plastic sachet containers then taken as a refreshing drink when chilled, the sharp taste of raw extract is usually sweetened with sugar cane or granulated sugar, pineapple, orange or other fruits depending on choice.. The sweetness of 'Zobo' drink does not last long due to spoilage by microbial activities; its shelf of life is approximately 48 hours following production if not refrigerated.

3. Result of Analyses

Table 1: Qualitative Phytochemical Analysis Result of *Hibiscus Sabdariffa*.

PARAMETER	DISTILLED WATER	ETHANOL	METHANOL	PETROLEUM ETHER	ETHYL ACETATE
Glycoside	++	++	++	+	++
Tannin	-	-	-	++	++
Emulsion Saponnin	++	+	-	++	++
Frothing	+	-	-	++	++
Alkaloid	-	++	++	-	-
Flavonoid	-	++	++	-	-
Phenol	++	-	++	-	-
Steroid	-	-	-	-	-

Table 2: Quantitative Phytochemical Analysis Result of *Hibiscus sabdariffa*.

PARAMETER	VALUE (%)
Saponnins	0.96
Flavonoids	20.08
Tannins	17.00
Phenols	1.10
Glycosides	0.132
Alkaloids	2.14

4. Discussion

The extracts of *Hibiscus sabdariffa* revealed the presence of plants secondary metabolites in the form of phytochemicals, vitamins and vital minerals. The biologically active chemical substances have curative properties. These phytochemicals include: tannins, saponnins, glycosides, phenols, and flavonoids extracted quantitatively and qualitatively. Table 4.1 shows the result of qualitative analysis which reveals the presence of these chemical substances and Table 4.3 reveals

their presence quantitatively in high percentages. This is similar to the work of [1] who revealed the presence of these phytochemicals in the leaves of *Hibiscus sabdariffa*.

The economic uses of the plant are as garden ornamentals and potherbs, used locally in Africa as source of dye, drink and as medicinal plant [15]. In Africa, the water extract of *Hibiscus sabdariffa* is taken as hot or cold drink. The leaves and calyces are used as vegetables in various local dishes [16]. *Hibiscus sabdariffa* plant is antiseptic, diuretic, purgative, sedative and emollient. The leaves in combination with ginger are used to suppress high blood pressure and in treatment of hypertension [17]. It can be used in making jams, jellies, ice cream, flavor and colourants in many drinks, a decoction of the leaves is taken as juice which helps in the improvement of health and immune system thus in the prevention of diseases in a research carried out by [3] in Nigeria.

In folk medicine, it has been used to treat cancer, inflammatory diseases and research has shown that the flowers contains anthocyanins, flavonoids and polyphenols which act as antioxidants or have other mechanism contributing to the cardioprotective actions [18, 19]. Beverages made from *Hibiscus sabdariffa* are used as cooling herb, providing relief during hot weather by increasing the flow of blood to the skin surface and dilating the pores to cool the skin [16]. The young leaves of the plant are eaten as cooked vegetable especially with soup. The seeds are pounded into meal which is used as oily soup or sauce after roasting and oil extracted from the seed is a substitute for castor oil while the residue is used in fermented form as soup or cake [12]. According to [17] a lotion made from *Hibiscus sabdariffa* leaves are used on sores and wounds. The ripe calyces, when boiled in water can be used to treat bilious attacks and cure ulcer and in combination with the flower can be used for tonic tea for digestive and kidney functions. In addition, the heated leaves are applied to cracks in the feet and on boils to speed maturation. In India, the calyces are used in producing food preserves as thickener and as flavourants in soups [8]. Primarily, the plant is also used for the production of bast fiber from the stem of the plant and as infusion; the fiber may be used as a substitute for jute in making burlap [6]. *Hibiscus sabdariffa* flower extract 'Zobo' drink has no empty calories; it is caffeine free and suitable for human consumption. *Hibiscus sabdariffa* is reputed to be effective against inflammatory skin disorders, most notably eczema [5]. Since most micro-organisms do not thrive under acidic conditions, it is recommended that the acidity of "Zobo" be increased such that it will not have effect on human health; by the addition of any acidic edible product e.g. fruit to suppress and inhibit the growth of unwanted pathogenic micro organisms like the *Staphylococcus aureus*, *Escherichia coli*, *Aspergillus spp* isolated. [15] recommend lime juice as a good acidic preservative after their investigation on the effect of lime juice concentration on the bacteria quality of Zobo drink with a view to prolong the shelf of life of Zobo drink. Since Zobo drink is easy to produce at home, packaged in polythene container and sold as source of incomes for most families. Therefore, the addition of lime juice should be encouraged because of its acidic contents and it is not hazardous and hence safe for human consumption. Furthermore, in order to enhance the keeping quality of Zobo drink, the processing environment should be hygienic while the packaging materials and additives should be adequately sterilized. Portable water should be used during processing to avoid bacterial contamination of the drink. Producers of Zobo drinks should be educated on control measures during processing to avoid

the hazardous effect of microbial contamination.

Researches have been made on the effect of *Hibiscus sabdariffa* extracts on various parameters in the metabolic processes. This work focused mainly on the phytochemical constituents present in the popularly known "Zobo" drink using distilled water, ethanol, methanol, petroleum ether and ethyl acetate as extractors of the plant. Biological processes and every enzyme require cofactors and coenzymes to function optimally, most of these cofactors are mineral elements. The results of this research work shows that the plant material (*Hibiscus sabdariffa*) is high enough in essential nutrients required for optimal performance of health and the maintenance of good health together with the reduction of aging. It is therefore encouraged to increase the intake of Zobo drink. The physico-chemical properties of Zobo were analyzed, which is normal and unharmed to health. In the microbiological properties, micro organisms were isolated but the presence of *Staphylococcus aureus*, *Escherichia coli* and *Aspergillus spp.* is pathogenic to human health. The presence of these poisonous micro organisms may be due to contamination by the material used in producing the Zobo juice and improper or lack of sterilization of the materials used, and the low acid content of the "Zobo" which cannot inhibit the presence of these micro-organisms.

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