



## Roselle drink: A privileged beverage with enormous economic and health benefits – a short review

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### ABSTRACT

*Hibiscus sabdariffa* L. (Roselle) is a species of flowering plant under the genus *Hibiscus* which is native to Africa, most likely West Africa and also found in India especially Maharashtra with the local name ambali. Roselle plant calyces are worldwide used for manufacturing of several products with vital health benefits. Roselle contains a significant number of bioactive compounds which contribute to the beneficial health effects of this material. Oxidative stress has received considerable scientific attention as a mediator in the etiology of many human diseases. Cell damage caused by oxidative stress is linked to many diseases including atherosclerosis, diabetes, and cancer. However, a broad range of health-revitalizing effects has been observed in Roselle drinks and tea since they are rich in anthocyanin; a potent bioactive compound with strong antioxidant potential. The intake of drinks rich in flavonoids which are a class of polyphenols exerts preventive effects against some chronic diseases. Anthocyanins possess antioxidant, anti-inflammatory and DNA protective properties and are strongly associated with many health benefits; Roselle drink therefore represents an admirable functional drink both for health and wellness.

### 1. INTRODUCTION

*Hibiscus sabdariffa* is an important multipurpose flowering plant of the Malvaceae family known with various vernacular names depending on their geographical area as Roselle, Sorrel, Karkade, Bissap, Zobo etc., however, the most common one is Roselle. It is a versatile and resourceful plant with decent claims of medicinal benefits and applications in the pharmaceutical and food industries in different parts of the world (Leong *et al.*, 2018; Riaz *et al.*, 2021).

*Hibiscus sabdariffa* was believed to be indigenous to India and migrated to other parts of the world like Australia, Africa, West Indies, and many tropical countries. The plant easily adapts to a wide range of climatic and soil conditions (Omemu *et al.*, 2006; Kilima *et al.*, 2014). The *Hibiscus sabdariffa* is cultivated essentially for its calyx which constitutes the most valuable part for the international market and they are of three types: green, red and dark red.

The red type is characterized by a concentration of anthocyanin (a bioactive compound) with strong antioxidant potential. The red calyces are the ones usually engaged in the production of both traditional and commercially packaged Roselle drinks (Tamara *et al.*, 2019; Serifat and Anthony, 2020). The prospect for the cultivation of Roselle for the production of calyces for export is huge, the Government of Nigeria disclosed recently that she could earn as much as over \$3 billion annually as soon as she starts exporting Roselle calyces to Mexico while signing a bilateral agreement for a trade partnership. The traditional method of drying and packaging is shown in Fig. 1.



Roselle plant



Dried calyx

**Fig. 1** Traditional drying and packaging

The growing awareness of functional drinks has increased research interest towards finding beverages with strong promise of health benefits. Roselle drinks as characterized by antioxidant, free radical scavenging and anti-ageing activities have been studied and found to be strongly linked to the prevention and care of chronic illnesses; it, therefore, assume a crucial importance in promoting health and wellness if regularly and moderately consumed (Greenlee *et al.*, 2012; Puro *et al.*, 2017). Roselle drink comes from properly dried calyx and this famous drink bears different names in different regions of the world (Jabeur *et al.*, 2017; Etheridge *et al.*, 2020).

Some French-speaking countries of West Africa called it Bissap, while in Nigeria; the common name is Zobo which is popular and served largely in the Northern part of Nigeria at local ceremonies as a refreshing cold drink or fun cocktail. It has acceptance among the diverse socio-economic class of West African Sub-region who regard the drink as an alternative to commercially produced carbonated kinds of stuff. This drink is becoming commercially packaged, branded and distributed like other drinks. An example of such is Zobocola which comes in 40cl and 50cl sizes. Roselle's drink is caffeine-free, red in colour and tastes like berries. Moderate intake of Roselle drink assumes no toxic side effects for consumers; however, overconsumption should be avoided.

Depending on preference, Roselle drink production could be sweetened with sugar and perhaps with the addition of pineapple, ginger and strawberry to flavour it up. Spices, such as ginger, garlic and clove have been also used for scent and to enhance keeping quality (Ezearigo *et al.*, 2014). Also, an investigation of quality attributes of *Hibiscus sabdariffa* (zobo) drinks blended with aqueous extracts of ginger and garlic as reported by Adesokan *et al.* (2013), discovered a higher concentration of vitamin C and suggested that the addition of some spices to Roselle could improve vitamin C status of the beverage. The goal of this study was to further highlight and emphasize the importance of Roselle drink as a gifted beverage desirable for human consumption for health benefits.

## 2. Local production of roselle drinks.

The process of Roselle drink production basically follows the same steps across different localities as illustrated in Fig. 2. however, some measures of modification could be introduced which are consequently responsible for the degree of variation in quality attributes such as colour intensity and product taste. Roselle drink is produced by hot water extraction of dried calyx of (*Hibiscus sabdariffa*). The calyces are rinsed properly before boiling in water and allowed to stay for about 15 min with the addition of ginger. After boiling, it is sieved to separate the drink from broken calyces then flavoured, allowed to cool down, packaged and refrigerated. (Adeniji, 2017).

### 3. Good production practices

The quality of beverages depends largely on good production practices. There are possible sources for contamination that could endanger the good quality of Roselle drink; the main sources of contamination are the: calyces used, processing environment, water source and equipment used. Other factors such as the packaging material and conditions of preservation and storage may also be included. However, the bulk of contamination for Roselle drink comes from the calyces used as a major raw material. Calyces used as raw material have been reported to get infested with microorganisms through the seed stock used, local growing conditions, and postharvest handling, especially during drying and storage. The high content of water in fresh calyces predisposes the calyces to infection; even if these calyces are later dried; some of the microorganisms remain.

Also, during sales at the local markets, Roselle calyces are usually placed in big containers or in polyethylene sheets uncovered; these may expose calyces to possible microbial contamination. The nutritional and consumer acceptability strength of any beverage production is a function of effective quality management systems that entail the quality of raw ingredients, processing layout, equipment's quality, and satisfaction of consumers with the final product. If any of these factors is defective, this may result in rejection of the product by consumers. To produce a roselle drink that will meet consumers' preferences and be safe for consumption, all the guidelines listed in good manufacturing practice must be strictly adhered to; failure of which can adversely affect the quality of the final product.

The production system must ensure and guarantee that the product produced does not contain any microbial contamination throughout the processing chain applied, thus, apart from a good working environment, personnel working should maintain a degree of robust personal hygiene and regulate personal habits that may affect production. Water treatment is also a critical step to ensure the good quality of the final product. Since water is a major component and represents (87%- 100%) of most drinks, water quality is directly linked with organoleptic, physiochemical properties and the product's microbial loads.

Removal of dirt and deteriorative components from processing water ensures beverage safety with considerable sensory properties. All physiochemical parameters such as taste, texture, acidity, brix, pulp concentration, additives levels, etc., should be suitably examined in accordance with the quality of the final product expected (Civille and Oftedal, 2012; Ashurst *et al.*, 2017).

### 4. Anthocyanins in Roselle drink

Anthocyanins are natural plant pigments that have beneficial effects for the plant as well as for humans. Dietary sources of anthocyanins are generally easy to identify due to their red, blue, or purple colour. Apart from *Hibiscus sabdariffa*; many fruit plants such as red raspberry, blackberry, bilberry, blueberry, grapes, zante currants, cherry, blood orange, red cabbage, red onion, purple sweet potato, red-skinned potato, fennel, eggplant, radish are very rich in antioxidants (anthocyanins) which are relevant to the human diet. The red varieties of roselle have strong antioxidant activity owing to its rich content from anthocyanin (Alvarez-Suarez *et al.*, 2014; Al-Ansary *et al.*, 2016). Anthocyanins in fruits and vegetables are present in glycosylated forms accumulating in cell vacuoles and distributed as follows: 50% cyanidin, 12% delphinidin, 12% pelargonidin, 12% peonidin, 7% malvidin, and 7% petunidin (Leong *et al.*, 2018).

They play a crucial role in scavenging radicals and protecting DNA from damage. The work done on eggplant rich in anthocyanin showed significant antioxidant activity by scavenging the oxygen-free radical with > 65% scavenging activity achieved in 2,2-diphenylpicrylhydrazyl (DPPH) assay (Li *et al.*, 2012; Li *et al.*, 2017). Anthocyanins have been considered a primary focus for researchers recently for their pharmacological effects, biological properties and high water solubility. Extracts derived from fruits and vegetables rich in anthocyanins are being studied and adopted as active ingredients in food fortification applications for health promotion (Joshi *et al.*, 2017). Moreover, anthocyanins are used as food additives in the production of coloured jams, confectionaries, and drinks. The utilization of anthocyanin as a colourant in yoghurt and some mixed fruit juices is becoming popular.

Oxidative stress comes from an imbalance between excess free radical accumulation in the body which is capable of causing damage to a wide range of vital biological macromolecules such as lipids, proteins and nucleic acids (Li *et al.*, 2012; Patra *et al.*, 2022). However, the availability of sufficient antioxidants in the body's system protects the body from various deleterious effects that could be caused due to free radicals, pollutants and toxins.

### 5. Potential health benefits of Roselle drink

The development of natural products from medicinal plants and fruit extracts with therapeutic usefulness are becoming popular due to increase in awareness of staying healthy by the people. Herbal medicine and food supplements to treat and manage various health ailments have been utilized for centuries and up till now. Food plants such as pawpaw, roselle cabbage, and amaranth contain vital constituents such as minerals, fibres, water-soluble vitamins, carotenoids, and polyphenols (e.g. anthocyanins) which provide health support for the body.

The healthy benefits of fruits and their corresponding juices have been linked to an array of their inherent bioactive compounds. Consequently, there is a growing demand for food drinks with sufficient bioactive compounds that could help prevent or treat some human diseases (Lema *et al.*, 2022). Administration of *Hibiscus sabdariffa* natural extract in experimental trials was found to exhibit strong antioxidant potential, and a significant effect on high blood pressure, anti-diabetic, cardiovascular prevention, and as well as hepatoprotective (Chiu *et al.*, 2022).

It was found that Roselle drinks modulate the body's metabolism, thus preventing obesity and fat build-up in the liver. Noteworthy, the Consumption of one cup of Roselle drink twice daily or as dried powdered extract equivalent of 250 mg anthocyanin per day was recommended for hypertension management (Ubom *et al.*, 2022). Some of the health effects of Roselle are illustrated in Fig. 3 below.



Fig.1 Dried calyx and its drink

Table 1. Diagnostic tests for Monkey pox

Nutrients	value
energy	232.27kj
calories	54.84kcal
carbohydrate	11.31g
fat	0.64g
protein	0.96g
Vitamain A	14µg
Thiamin(B <sub>1</sub> )	0.011mg
Riboflavin(B <sub>2</sub> )	0.028mg
Niacin (B <sub>1</sub> )	0.031
Vitamin C	12mg
calcium	215mg
iron	1.48mg
magnesium	51mg
Phosphorus	31mg
potassium	208mg
sodium	6mg

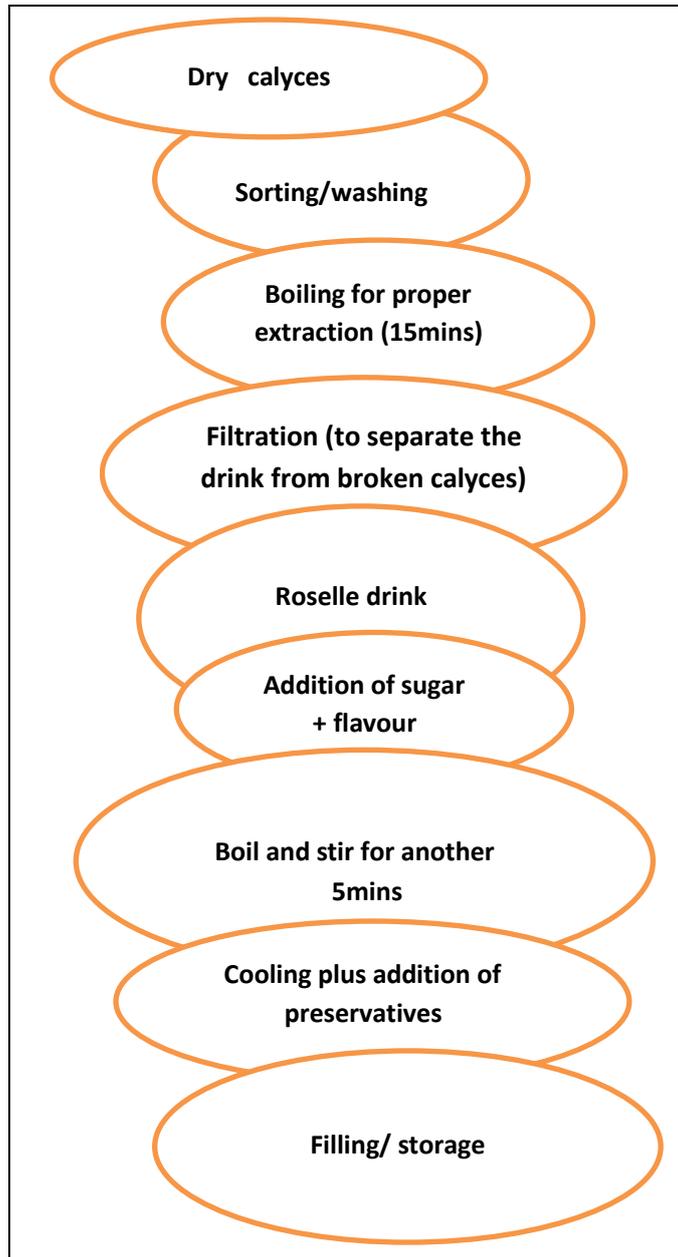


Fig. 2 Basic flow chart of Roselle drink

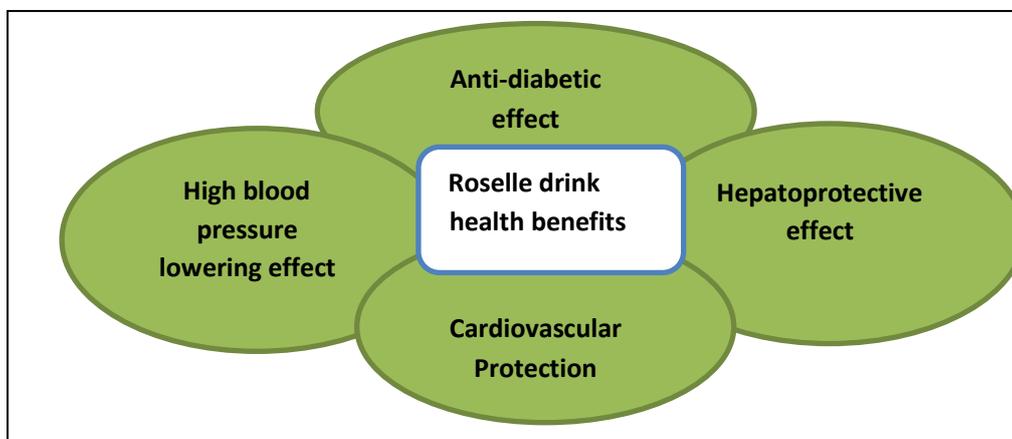


Fig. 3 Some health benefits of Roselle drink

### 6. Cardiovascular protecting effect

Cardiovascular disease (CVD) is a general term describing abnormal conditions affecting the heart or blood vessels, usually associated with a time build-up of fatty deposits inside the arteries (a condition known as atherosclerosis) and for an increased risk of blood clots. Globally, it is one of the causes of mortality. Several physiological regulations have been implicated in leading to cardiovascular disorders such as high plasma LDL cholesterol, hypertension, endothelium dysfunction, and platelet aggregation. Apart from all these, oxidative stress is also one of the major risk factors for cardiovascular disorders. Anthocyanins in Roselle drinks do play a vital role in protecting against such oxidative stress that could eventually lead to cardiovascular disorder (Bell and Gochenaur, 2006).

The chemical anthocyanin shows a vasodilator effect upon the consumption of red wine or Roselle drinks that are rich in them. Literature suggests that during a heart attack, ingestion of grape juice, which is rich in anthocyanins, could exhibit strong antioxidant activity by increasing capillary permeability and strength. This action leads to inhibition in platelet formation and speeds the nitric oxide (NO) production, which results in vasodilation (Erlund et al., 2008). Also, clinical trial studies conducted in healthy participants have also shown that eating anthocyanin-rich strawberries for a period of more than a month improves both the lipid profile and platelet function (Alvarez-Suarez et al., 2014).

### 7. Hepatoprotective effect

The liver has a crucial role in many essential physiological processes; however, it is vulnerable to a wide range of toxic, microbial, metabolic, and circulatory assaults. Liver diseases are considered as one of the most serious health problems, in addition, treatment options are limited to drugs with possible risk of side effects and they are seemingly expensive (Ohguro et al., 2012). Roselle has been shown to have an antioxidant function protecting the liver from damage by increasing the antioxidant enzymes in the liver (Kolawole et al., 2022). Many investigations highlight the role of polyphenolic acid, flavonoids and anthocyanins that may act directly as antioxidants or via other mechanisms contributing to the hepatoprotective actions. Thus, dietary extracts of Roselle may reduce the incidence of liver stress through their antioxidant activity.

### 8. Blood pressure lowering effect

Blood pressure is the force that moves blood through the circulatory system; it is an important force that brings about the circulation of oxygen and nutrients. High blood pressure or Hypertension is defined in most major guidelines as systolic blood pressure (SBP) of 140 mmHg or greater and/or diastolic blood pressure (DBP) of 90 mmHg or greater (Unger 2020). Hypertension is considered to be a serious health problem worldwide so controlling and lowering blood pressure are of significant benefit to people with hypertension because hypertension is considered a risk factor for stroke, heart failure, and cardiovascular diseases (CVDs). CVDs are a group of disorders of the heart and blood vessels and include coronary heart disease, cerebrovascular disease, rheumatic heart disease and other conditions which are the leading causes of death globally, taking an estimated 17.9 million lives each year (WHO, 2020). Roselle, which is also called red tea, has been used as a thirst-quenching drink observed to appreciably lower blood pressure by removing excess fluids and allowing the blood vessels to relax in people suffering from pre- and mild hypertension.

In fact, adding Hibiscus to the diet was reported to be just as effective as taking the popular anti-hypertensive drug, e.g. Captopril. In a case study conducted on elderly women above 60 years with the case of hypertension, they were treated with Roselle drink (5 calyces boiled in 150 mL of water) two times a day after meal. There was a reduction in both systolic and diastolic blood pressure after 21 days of treatment (Yusni and Meutia, 2020). Another study by Herrera-Arellano (2007) assessed the extract of Roselle calyces on one hundred and sixty-eight patients with stage I or II hypertension aged 25 to 61 years. They reported also a decrease in blood pressure from 146/98 mmHg to 130/86 mmHg. It was concluded that Roselle exerts important antihypertensive effectiveness with a wide margin of tolerability and safety. Roselle extract appeared to be as effective as captopril which is a medication used alone or in combination to treat high blood pressure (Walton et al., 2016; Singh et al., 2017).

### 9. Antidiabetic effect

Diabetes is lifetime risk problem and one of the leading causes of morbidity and mortality worldwide that possess a major threat to national development as it causes high economic loss (Vasim et al., 2012; Sabiu and Ashafa, 2016).

It is a disease of metabolic deregulation, most notably abnormal glucose metabolism, accompanied by characteristic long-term complications (Vasim *et al.*, 2012). It should be controlled through intake of regular medication. When uncontrolled, diabetes may lead to many secondary complications such as cataract, heart failure, and renal failure. Although there are many known antidiabetic medicines in the pharmaceutical stores, however, the dependence on drug has and the possible economic burden on individuals and families may prevent the affected patient from continuous usage (Kavishakar *et al.*, 2011).

It becomes a major priority therefore to research into new potentially antidiabetic natural agents of plant origin that contain known effective constituents that are safe and affordable. Serum glucose levels after oral administration of *H. Sabdariffa* extract to diabetic induced rats was found to normalize within two weeks of administration, similarly to the effect experienced with the administration of diabetic drugs (Glibenclamide and metformin), confirming the extract hypoglycaemic properties. According to Valverde *et al.* (2012), glibenclamide lowers blood sugar through the mechanism of stimulation of insulin secretion and prevents glucagon secretion; thus, lowering blood sugar. It was argued that *H. sabdariffa* calyx extract may possibly achieve the same effect through a similar mechanism.

## 10. CONCLUSION

The functional food concept was developed from the consumption of a diet rich in fruits, vegetables and drinks with promising health benefits that guarantee a healthy and wholesome lifestyle. The review presented the significance of *Hibiscus sabdariffa* as material for functional drinks with critical health benefits for mankind. The drink aside from providing basic nutrients, supplies biologically active polyphenols (anthocyanin) vital and useful in the prevention and management of chronic diseases. Anthocyanins are one of the largest and most important groups of water-soluble pigments in most species in the plant kingdom. Depending on the nutritional habits, the daily intake of anthocyanins for individuals as well as other flavonoids occurring in many fruits, and vegetables is protective against a variety of diseases, particularly cardiovascular disease and some types of cancer.

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