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APPLICATIONS, CURRENT AND FUTURE PROCESSING TECHNOLOGIES OF *HIBISCUS SABDARIFFA* (ZOBO) FRUIT: A COMPREHENSIVE REVIEW

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Abstract: Crucial aspects of *Hibiscus sabdariffa* (zobo) plant cultivation / production and its fruit processing are to be well understood before possible venture into its product development. Therefore, this review paper attempts to highlight the overview of zobo plant, its cultivation /production, challenges and nutritional values. Besides, the applications of zobo plant, its drink production (both conventional and modern-day techniques), rationale for value addition to its products, current and future technologies of its calyx processing were also elaborated in broad perspectives. If these aspects are fully employed coupled with the emerging technologies on ground, the development of hygienically safe zobo products could be possible.
Keywords: Hibiscus sabdariffa fruit, Processing technologies, Zobo products

1. INTRODUCTION

Demand for *Hibiscus sabdariffa* (zobo) plant has gradually been increased recently. Unfortunately, its cultivation and subsequent production of zobo products, for teeming consumers and possible exportation for foreign exchange (i.e., both zobo farmers and the national income), are faced with certain limitations. Hence, this review paper attempts to look at the cultivation, applications, current and future processing technologies of *Hibiscus sabdariffa* (zobo) fruit in a broad perspective. These aspects are to be properly articulated before a reasonable venture into zobo products development is considered.

Hibiscus sabdariffa (zobo) plant is a yearly or perennial herb, woody subshrub. It grows up to the height of 200–250 cm. The leaves are about 3 -5 in lobe and organized one after the other on the stems. They are approximately 8.5–15 cm long. The flowers are 80–100 mm in diameter, white to light yellow with a deep red spot at the base of each petal (generally, 5 petals) and possess a firm fleshy calyx at the base. The calyx is 10–20 mm wide, increases to 35 mm, and becomes bright red when the fruit matures at about 6 months. This variety of hibiscus (Roselle) is found mostly in Sudan and West Africa. It is predominantly cultivated and consumed in Nigeria (Wikipedia, 2021). However, other species of Hibiscus plant include:

— *Rosa sinensis:* This is mainly cultivated in China as an ornamental plant;
— *Hibiscus syriacus*: This type comes from the Central and Southeast China;
— *Hibiscus schizopetalus:* This kind is found in tropical eastern Africa (Kenya, Mozambique and Tanzania).

However, *Hibiscus sabdariffa* has several varieties in terms of colour. These include the dark red, wine and bright red hibiscus (Andrew, 2019). Moreover, the zobo plant with flower, fresh and dried calyces are shown in Figure 1.

Figure 1: (a) *Hibiscus sabdariffa* (zobo) plant with flower; (b) Fresh calyces; (c) Dried calyces. Source: Wikipedia (2021)

Nevertheless, different parts of the world have unique names for *Hibiscus sabdariffa* (zobo) plant. Arabic nations, Burmese, Chinese and Australia call it " karkadeh", "chinbaung", "iuoshen hua", "rosella fruit", respectively, whereas Southwest Nigeria (Yoruba) and Northern Nigeria (Hausa) name it, "isapa" and "gurguzu" respectively. In Ghana and Jamaica, it is known as "sobolo" and "saril or flor de Jamaica or sorrel", respectively. It is also known as "sorrel" in Carribean, Trinidad and Tobago, and some islands in West Indies (Wikipedia, 2021).

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2. CULTIVATION, PRODUCTION AND CHALLENGES OF *HIBISCUS SABDARIFFA* (ZOBO) PLANT

Cultivation of *Hibiscus Sabdariffa* (Zobo) Plant

The following practices are carried out in the cultivation of *Hibiscus sabdariffa* (zobo) plant:

— Soil Preparation: The hibiscus plant flourishes well on a sandy-loamy soil. The soil pH of 5.5 – 6.0 flavours its cultivation. Hence, acidic soil is recommended;

— Planting and Propagation: Hibiscus plant may be propagated in two ways:

(a) by seed broadcasting and

(b) stem propagation.

For seed broadcasting, the seeds are soaked in water overnight and then raised in nursery beds in pots or containers; whereas for stem propagation, stem (about 12.7 to 15.2 cm long) is obtained from the parent plant. Liquid fertilizer can be used to enhance root growth and development. It takes the propagated stem 8 to 10 weeks to develop;

— Irrigation: During the hot and dry seasons, hibiscus plant cultivation requires regular water supply. When there is no water in the soil, the top leaves may turn into yellow or drop down;

— Manure Application: Hibiscus plant demands a lot of soil nutrients to grow. Potassium fertilizer is approved for the superb flowering as manure for the plant. Besides, farmyard manure or garden compost can also be used;

— Harvesting: Different cultivars are harvested at different periods;

— Drying: Mature flowers are spread traditionally on a mat in direct sun to dry. This process may take a few days, based on the climatic condition. As soon as they are absolutely dried, they become smaller in size and turn brittle (Ondo, 2020; PFAF, 2021).

Production and Challenges of *Hibiscus Sabdariffa* (Zobo) Plant

Presently, over 15,000 metric tons of *Hibiscus sabdariffa* (zobo) plant is recorded in the global market each year. However, Nigeria is one of the highest international producers and suppliers of hibiscus flowers. The species grown in Nigerian is unique and is obtained from six states in the Northern parts of the country. These include: Katsina, Kano, Gombe, Bauchi, Jigawa and Borno. The Nigerian zobo plant sector is projected at $100 million value. Nigeria had exported approximately 1,983 containers of zobo flowers to Mexico alone in 2017, which earned about $35 million in 9 months as reported by the Association of Hibiscus Flower Exporters of Nigeria (AHFEN). However, the challenges of hibiscus production in Nigeria include:

— inadequate capital investment;

— attack by pests and diseases;

— since, it is a seasonal plant; it may be difficult in sourcing it at a particular time of the year;

— inadequate marketing policy among traders;

— skyrocket labour demand;

— poor experience in cultivation;

— shortage of suitable planting locations;

— little awareness of hibiscus plant potential among farmers; and

— inadequate research and knowledge of the hibiscus plant (Gbenga, 2019; Ondo, 2020)

3. NUTRITIONAL VALUES OF *HIBISCUS SABDARIFFA* (ZOBO) FRUIT

Hibiscus sabdariffa (zobo) fruit contains valuable nutrients as shown in Table 1 (Olayemi *et al.,* 2011).

Table 1: Nutritional values of *Hibiscus sabdariffa* (zobo) fruit

Samples	Ash (ppm)	pH	Protein (ppm)	Ca (ppm)	Mg (ppm)	Na (ppm)	K (ppm)	Fe (ppm)	Vitamin C (%)
Dark red	15.5	2.53	0.08750	4.00	5.75	35.78	220	0.67	7.5
Bright red	14.0	2.50	0.08750	2.00	13.25	25.11	219	0.67	5.0
Wine	12.0	2.67	0.04375	2.67	7.88	50.67	235	1.17	5.0

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4. APPLICATIONS OF HIBISCUS SABDARIFFA (ZOBO) PLANT

The applications of *Hibiscus sabdariffa* (zobo) plant include:

— Vegetable: The leaves of *Hibiscus sabdriffa* and *connabinus* can be cooked with chicken, fish, pork or crab as a meal in Bodo land, India. Its leaves and flower are used in making chicken stew in Philippines;
— Bast Fibre: It is used in producing bast fibre, which could substitute jute in the production of burlap;
— Food Colouring / Flavours: Its leaves can render flavour and colour to dishes. A typical example is found in rice dish and fish in Senegal:
— Beverages: Sorel drink is produced from its sepal in Caribbean. In Africa, mainly in the Southern parts, rosella is used for making surgery herbal tea, whereas in Thailand, it is drunk as hot tea and as cold drink (Ibobvalla, 2021);
— Jam and Preservative: It is used in making jam from the colonial time and as a preservative in Nigeria;
— Herbal Medicine: It is one of the available food material with very high antioxidant content. It has vitro antimicrobial action against *E. coli*. The zobo drink has numerous vitamins (vitamin B1 [thiamine], B2 [riboflavin], B3 [niacin], Vitamin A [retinol]), carotene and minerals [calcium, iron, etc] fiber, free caffeine, 15-30% organic acids [tartaric acid, citric acid, and maleic acid] etc., and as such its drink is able to reduce blood pressure, the risk of cardiovascular disease, blood flow by blocking the production of amylose; control weight, diabetes, prevent cancer, anaemia and constipation; but improve immune system, support brain functioning, maintain general body metabolism (Rosella, 2004; Yinka, 2013; Oluwatomiwa, 2014)
— Psychochemical: Its leaves are excellent source of poly pherudic compound. These include chlerogenic acid, necholorogenic acid and falconoid complexes such as uncertain kampferol and their derivatives;
— Hair Care Products: Hibiscus plant is used to produce hair oil, shampoos and conditioners. Hair products are vital for scalp and hair nourishment, preventing hair fall and dandruff removal;
— Animal Feed: The hibiscus seeds and leaves could be used in making animals feeds. These feeds could be in fresh or dried form for ruminants (as mainly protein feed) and layers [in poultry] (as carotene source) (Yinka, 2014; Gbenga, 2019);

5. PRODUCTION OF ZOBO DRINK IN NIGERIA

Zobo drink is now popularly consumed in many regions of the world. It is prepared in Nigeria depending on the availability of flavours and choice.

Conventional (Traditional) Method of Zobo Drink Production

Dried zobo calyces are sourced and cleaned manually to get rid of the unwanted materials. Thereafter, they are washed in a basin filled with water at room temperature.

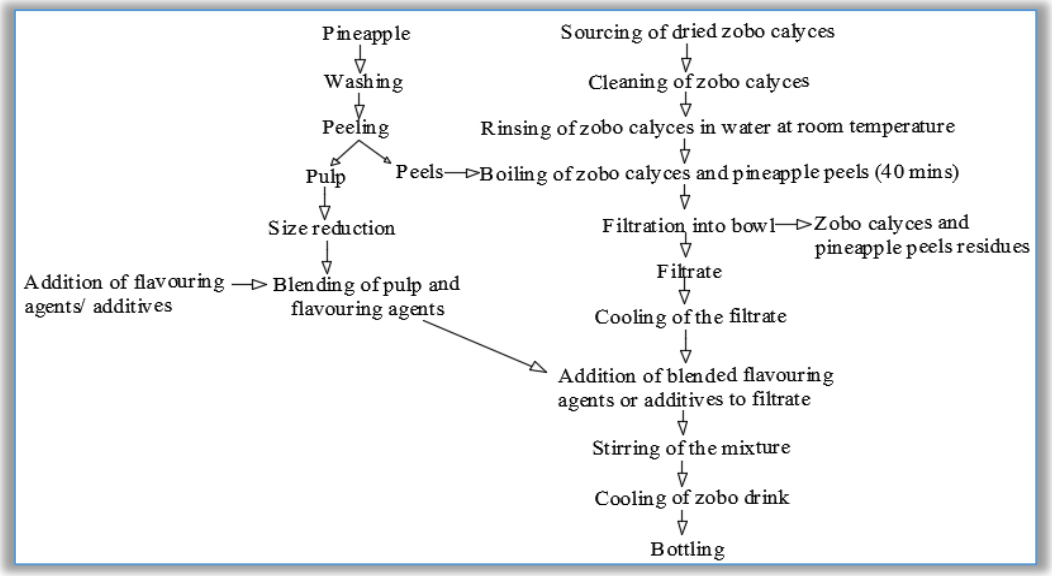

Figure 2: Flow chart for conventional method of zobo drink production

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Pineapple fruit is got, rinsed in water and peeled. The peels are cut in pieces, added to the chopped zobo calyces and boiled for 40 minutes. Pineapple pulp is size reduced and blended using electrical grinder with desired flavouring substances such as ginger, honey, etc. The boiled mix is then filtered. The filtrate collected in a large pot is allowed to cool by natural convection whereas the pineapple peels and zobo calyxes' residues may be disposed (or used as manure). The blended flavouring substances (additives) are added to the chilled filtrate and mixed appropriately using a wooden stirrer. The drink is lastly allowed to cool, bottled and is ready to be served. Nevertheless, the conventional method of zobo drink production is shown in Figure 2 (Chidirim, 2017; Andrella, 2021).

6. RATIONALE FOR VALUE ADDITION TO ZOBO PRODUCTS

The conventional or traditional method of processing zobo fruit into drink is characterized by the followings:

— the method is susceptible to contamination by bacteria due to poor sterilization;
— the fruit drink may rapidly undergo fermentation as a result of poor handling and storage facilities;
— increase in the drink temperature due to climate change;
— the production is labour intensive; and
— the bottles are unbranded etc.

To curb these challenges and increase the income of zobo fruit farmers, value addition to zobo products is recommended. Zobo calyces could be made into well bottled branded sterilized fruit drink and in powdered form which could be packaged in sachet like Lipton tea, etc.

Modern-day Unit Operations in Zobo Fruit Drink Processing

Modern-day unit operations in zobo fruit drink processing are as follows:

— Harvesting: Matured zobo calyces are reaped with the help of a sickle and packed in a container;
— Drying: Zobo calyces could be dried using any available dryer such as oven, solar, freeze dryer, etc. (Alonge and Adeboye, 2012);
— Cleaning: The dried zobo calyces are cleaned using air in aspirator or cyclone to remove foreign materials such as dust, debris, etc. Then, sieves with different aperture sizes could also be used to further separate either the smallest or largest unwanted materials. The dried zobo calyces could then be washed with water in a vessel to remove dust and heavier particles like pebbles, stones, etc. They are then emptied in a basket –like vessel to drain all the moisture or allowed the natural air flow to pass across and dry the calyces;
— Extraction: The calyces are put into a large vessel with clean water. The vessel is then covered and boiled for 10 – 15 minutes. The heat could be supplied by burning gas or electricity;
— Cooling: The hot liquor is allowed to cool in a refrigerating system or heat exchangers;
— Filtration: The cooled liquor is filtered using micro filter system made of clean fibre cloth. The residue of the spent calyces is received and disposed as appropriate. The filtrate is then channeled into a large tank;
— Flavouring: Already blended flavouring agents from peeled ginger, pineapple, garlic, orange, etc. are injected using a certain metering device depending on the precise amount required;
— Agitation and Boiling: The blended mix is agitated mechanically using a stirrer attached to the tank and boiled for 5 minutes;
— Cooling and Addition of Spices/ Preservatives: The liquor is cooled in a refrigerating system before the desired spices and preservatives (honey, lime, etc.) are added into the liquor and mixed properly;
— Bottling: The resulting liquor is passed through the bottling line where the empty and already washed bottles are filled with the liquor and then packed.

The above unit operations are illustrated in Figure 3a (The Nation, 2018).

Processing of Zobo Calyces into Water Soluble Powder

The unit operations in the production of water soluble powder from zobo calyces are as follows:

— Pre-washing: The dried zobo calyces are washed with clean water in a vessel for 15 minutes to remove debris, sand and other foreign materials so as that the quality of the finished product will not be affected. They are later removed and drained;

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— Size Reduction: The drained zobo calyces are cut into smaller sizes using a cutter. This creates a large surface area for water (solvent) contact and quick extraction of soluble component;
— Extraction: When the chopped calyces are dipped in a clean vessel containing water at about 56.8 ^{0}C (300K), the soluble solid phase of the substance will dissolve in the liquid phase under dissolution of minerals, desorption, etc. to form solution;
— Filtration: The solution got from extraction operation, is channeled through filtration system. The filtrate is then separated from the insoluble solid residue (spent zobo calcyes);
— Flavouring: Flavours such as powdered orange, ginger, lemon, lime juice etc. are added to the extract;
— Concentration of Extract**:** In this operation, an evaporator is employed to remove certain quantity of moisture from the aqueous solution of zobo extract. The evaporation is done by boiling the liquor in an appropriate container where the vapour is given off;
— Spray Drying: Spray drying is a technique used in producing a dry powder of any substance from a liquid or slurry (concentrated zobo calyx extract). Here, the liquid stream is sprayed through a nozzle of a spray dryer against or along a hot vapour stream. The hot vapour stream rapidly evaporates the moisture from the droplets which finally form powder. The powder is then received through the product outlet;
— Packaging: The products are then packed in sachets and ready for storage.

However, the unit operations are illustrated in Figure 3b (Coulson and Richardson, 1999, Etti *et al.,* 2022).

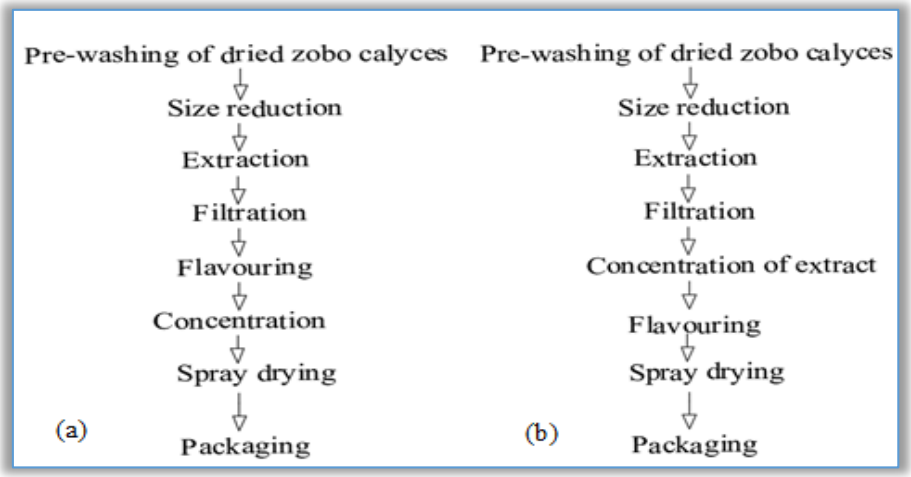

Figure 3: (a) Unit operations in (a) zobo fruit drink processing and (b) the production of water soluble powder from zobo calyces

7. CURRENT / FUTURE TECHNIQUES OF ZOBO CALYX PROCESSING

In modern food processing industry, several back-up techniques are employed to attain hygienically safe, convenient, smart and effective production processes. These include: information communication technology (ICT) / modernization, artificial intelligent (AI), automation and hyper imaging. Typical applications are displayed in Figure 4.

Figure 4: (a) ICT / modernization in food industry; (b) Artificial intelligent in zobo production process; (c) A typical sorting system with laser beam; and (d) Modern clean-in place system in food industry. Source: Shubhada (2012); Sysadmins (2020)

ICT / modernization could be employed in the production of zobo drink or soluble powder product (Figure 4a). However, the advantages of ICT/ modernization in food industry include (Shubhada, 2012):

— Improvement of Product

Here, several monitoring equipment, humidity and temperature sensors could be used to control or monitor production stages and storage condition. Besides, the use of real-time temperature tracking sensors permits food industry to carefully monitor food safety data points, promising dynamic cold chain management. This prompts staff to perform and verify compulsory food safety examinations.

— Promotion of Efficient Logistics

Food industries can employ internet of things (IoT) technology to monitor inventory in real time, and program shipments based on demands or predictions for replenishment. It permits shippers to track product location with geographical positioning system (GPS). This will finally help shippers in comprehending customer's behaviour to lessen dead miles in trucks.

— Transparent Supply Chains

The use of ICT/ modernization could enhance transparent supply chain where customer's trust and loyalty are established.

— Increase in Operational Efficiency

Operational efficiency can be improved by incorporating workflows and reducing manual processes, linking business groups and systems, and rearranging processes.

— Saving of Energy

ICT/ modernization can be used to reduce energy consumption by some heavy equipment. Here, energy management solution (EMS) gathers data, from intelligent gadgets, analyzes and displays power consumption data for immediate action. For instance, boiler or spray dryer and heater with smart sensors can maintain a predefined temperature of the product.

Artificial Intelligent (AI)

AI could be employed in the production of zobo drink or soluble powder product (Figure 4b). Nevertheless, the advantages of the application of artificial intelligent in a typical food industry include (Sysadmins, 2020):

— Sorting of Food Products and Packages

AI systems use numerous tools and technologies like lasers, cameras, X-rays, and near infrared spectroscopy to quickly analyze each facet of the zobo fruit as it comes into the factory. Sorting could be based on colour, etc. This enhances sorting process and minimizes labour cost. A typical sorting system with laser beam is shown in Figure 4c.

— Aid Customers in Decision Making

Customers can select their favourite food product based on the new-flangled flavour mixtures generated by AI system.

— Enhancing Cleaning Process Equipment

Clean-in-place system with designed AI program uses optical fluorescence and ultrasonic sensing imaging tools to collect data and display how much microbial load, debris and soils had left either the internal or external equipment. A classic modern clean-in place system in food industry is displayed in Figure 4d.

— Development of New Products

AI assists food industry to decide what new products to manufacture based on data collected on the customer choices.

— Improvement of Personal Hygiene

AI guarantees that the food factory is run with rules and regulations. Cameras in zobo drink processing line could watch and make sure that workers wear masks or hair protection as required by safety regulations. Violations can be detected and corrected on the spot. Distinctive AI cameras in food industry are shown in Figure 5.

Automation

Automation could be employed in the production of zobo drink or soluble powder product. A typical fully automated food industry is shown in Figure 6.

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Figure 5: AI cameras in food industry. Source: CCTYMEA (2021)

The advantages of automation of a typical food industry includes (Harnil, 2021):

- Improved Productivity: Automation creates room for resourceful work flow scheduling and labour usage;
- Improved Product Quality: Food industry employs automatic systems for quality assurance and quality control;
- Improved Profitability: Automation aids to enhance product quality and productivity. They play very important role in improving profitability. Computer-controlled plant operations offer practically unlimited prospects to keep records of all events during plant operation. Furthermore, the capability to collect, store, retrieve, and process data permits food industry to spot out areas of concern.

Figure 6: A typical automated food industry. Source: Harnil (2021)

Hyper Imaging

Hyper spectral imaging compounds infrared spectroscopy with machine vision to create images which could be colour coded according to the chemical constituents of the food material being imaged. Its ability to recognize variations in the chemical constituents of organic materials unlocks new possibilities for identifying impurities in food products. Typical application of hyper spectral imaging in the food processing industry is shown in Figure 7 (Mark, 2018).

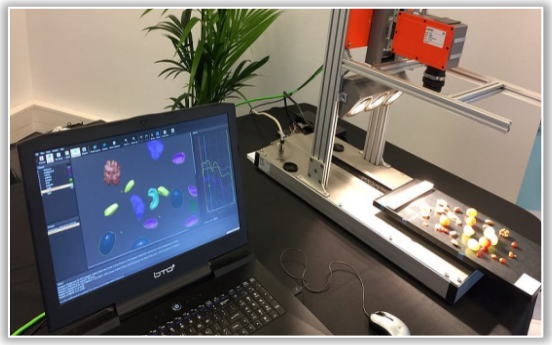

Figure.7: Hyper spectral imaging system. Source: Mark (2018)

7. CONCLUSION

Besides, different areas of applications in the food processing industry include:

- Detecting foreign materials (e.g. plastic pieces or insects in the products);
- Measuring product quality (e.g. concentration of solids, homogeneity, colour, etc.); and
- Regulating various unit operations or production stages (e.g. before and after filtration, mixing, etc).

However, classical applications in the food packaging industry include:

- Exclusion of contaminants during sealing operation;
- Enhancement of product consistency and uniformity; and
- Guaranteeing that the packaging material will enhance product quality assurance (Mark, 2018).

The production of hygienically safe zobo products could be possible if all the aspects unveiled in this review paper are properly utilized coupled the emerging technologies on ground.

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References

[1] Alonge, A. F. and Adeboye, O. A. (2012). Drying rate of some fruits and vegetables with passive solar dryers. International Journal of Agricultural and Biological Engineering (IJABE), China, 5, (4), 83-90.
[2] Andrella, T. (2021). Zobo Drink Production and Preservation in Nigeria. Online at https://www.legit.ng/1143846-zobo-drink-production-preservation-nigeria.html (Accessed on 27th Nov., 2023)
[3] Andrew, O. A. (2019). Zobo Consumption and its Nutritional Health Benefits. Online at https://dutable.com/2019/02/19/zobo-consumption-and-its-nutritional-health-benefits/ (Accessed on 27th Nov., 2023)
[4] CCTVMEA (2021). CCTV's Importance in Food Processing Industry. Online
[5] Chidirim, N. (2017). How to Make Zobo Drink in Ten Easy Steps. Online at https://guardian.ng/life/food/how-to-make-zobo-drink-in-ten-easy-steps/ (Accessed on 27th Nov., 2023)
[6] Coulson, J. M. and Richardson, J. J. (1999). Separation Process and Particulate Matter. Replica Press, India.
[7] Etti, C. J., Alonge, A. F., Oladejo, A. O.,Akpan, M. G., Okoko, J. U. and Etuk, N. I. (2022). Effects of particles size on tea processing: A perspective on zobo production. European Journal of Agriculture and Food Sciences, 4 (4), 11-18
[8] Gbenga, A. (2019). Getting Best of Hibiscus Flower for Export. Online at https://guardian.ng/features/getting-best-of-hibiscus-flower-for-export/ (Accessed on 1st August, 2023)
[9] Harnil, O. (2021). The Impact of Artificial Intelligence in Food Industry. Online at https://customerthink.com/the-impact-of-artificial-intelligence-in-food-industry (Retrieved on 27th Nov., 2023)
[10] Ibobvalla, I. (2021). Shocking Health Benefits of Zobo Drink. Online at https://healthbenefitsof.org/15-shocking-health-benefits-of-zobo-drink/ (Accessed on 27th Nov., 2023)
[11] Mark, W. (2018). Hyperspectral Imaging Applications in Food and Packaginghttps://www.novuslight.com/hyperspectral-imaging-applications-in-food-and-packaging_N8149.html (Retrieved on 27th Nov., 2023)
[12] Olayemi, F., Adedayo, R., Muhummad, R. and Bamishaiye, E. (2011). The nutritional quality of three varieties of zobo (Hibiscus sabdariffa) subjected to the same preparation condition. American Journal of Food Technology, 6, 705-708.
[13] Oluwatomiwa, A. (2014). Health Benefits of Zobo (Roselle or Hibiscus) Drink. Online at https://www.healthycase.blogspot.com (Accessed on 27th Nov., 2023)
[14] Ondo (2020). How to Start Hibiscus Farming Business in Nigeria or Africa: Guide.Online at https://ondoonline.com/entrepreneurship/how-to-start-hibiscus-farming-business-in-nigeria-or-africa-guide/ (Accessed on 27th Nov., 2023)
[15] PFAF (Plant for A Future) (2021). Hibiscus sabdariffa - L. Online at https://pfaf.org/user/Plant.aspx?LatinName=Hibiscus+sabdariffa (Accessed on 27th Nov., 2023)
[16] Rosella, N. (2004). *Zobo Lowers High Blood Pressure.* Academic Press, New York.
[17] Shubhada, K. (2012). Ways IoT is Transforming the Food and Beverage Industry. Online at https://www.einfochips.com/blog/5-ways-iot-is-transforming-the-food-and-beverage-industry/ (Retrieved on 27th Nov., 2023)
[18] Sysadmins, A. (2020). Applications of AI in Food Processing Industry https://usmsystems.com/artificial-intelligence-in-food-processing-industry/ (Retrieved on 27th Nov., 2023)
[19] Wikipedia 2021. Wikipedia, the Free Encyclopedia. Online at https://en.wikipedia.org/wiki/Zobo (Accessed on 27th Nov., 2023)
[20] The Nation (2018). Requirements for Zobo Drink Production. Online at https://thenationonlineng.net/requirements-for-zobo-drink-production (Accessed on 27th Nov., 2023)
[21] Yinka, S. (2013). Zobo Nutritious Healthy Local Drink (Roselle Sabdariffa). Online at http://www.dialyindedentnig.com (Retrieved on 13th Nov., 2023)
[22] Yinka, S. (2014). Zobo Business Production. *Daily Independent.* Online at https://independent.ng/zobo-drink-production-business/ (Retrieved on 27th Nov., 2023)

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