EVALUATION OF THE NUTRITIONAL VALUE AND CHEMICAL COMPOSITION OF CARROT (*Daucus carota*)

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A PROJECT SUBMITTED TO THE DEPARTMENT OF CHEMISTRY, UNIVERSITY OF BENIN, BENIN CITY, IN PARTIAL FULFILMENT OF THE REQUIREMENT FOR THE AWARD OF BACHELOR OF SCIENCE DEGREE (B.SC HONOURS) IN CHEMISTRY

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CERTIFICATION

This is to certify that this research project was carried out by ENORENSE OBADEYI with the matriculation number PSC1908665 under the supervision of Dr. M.I. Imafidon. in the department of chemistry, faculty of physical sciences, university of Benin, Benin City.

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(Head of department)

DEDICATION

This project research is dedicated to the Almighty God who in His infinite mercy saw me through my journey in the University of Benin, and to my loving parents.

# ACKNOWLEDGEMENT

I want to express my profound gratitude to Almighty God for the strength and enablement to complete this work and for making my academic journey a success.

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ABSTRACT

Carrot (*daucus carota)* is an important root vegetable, which has various bioactive compounds like carotenoids and dietary fibers with appreciable levels of several other functional components having significant health-promoting properties. The consumption of carrot and its products is gaining rapid attention because it has been identified as an important source of natural antioxidants having anticancer activity. Apart from carrot roots being traditionally used in salad and preparation of many cuisines, carrots could commercially be converted into nutritionally rich processed products like juice, concentrate, dried powder, canned, preserve, candy, pickle, and g*azrailla*. Carrot pomace containing about 50% of β-carotene could profitably be utilized for the supplementation of products like cake, bread, biscuits and preparation of several types of functional products. This research work highlights the nutritional composition, health promoting phytonutrients, functional properties of carrot and by-products utilization of carrot along with the potential application of these products. It has been shown that the carrot has a moisture content of 25.34%, ash content 8.21%, crude fibre 3.08%, crude fat 5.07%, protein 4.15% and carbohydrate of 54.15% these findings proves that the carrot is of good quality. The presence of mineral elements such as Zinc (2.5mg/kg) Manganese (0.6mg/kg), Iron (2.09mg/kg), Magnesium (20.6mg/kg), Calcium (18.50mg/kg). indicates its safe consumption while the presence of bioactive compounds such as glycosides, saponins, phenolics, eugenols, terpenoids, alkaloids, flavonoids and tannins all contribute to its nutritional values.

Table of Contents

CHAPTER ONE

INTRODUCTION

1.1.1 BACKGROUND STUDY

Carrots (*Daucus carota subsp. sativus*), originating from Afghanistan around 900 AD (Iorizzo and Massimo 2007), they are root vegetables known for their economic importance and wide cultivation across the world. Initially, carrots were purple or yellow, with orange carrots emerging in Central Europe during the 15th or 16th century. Today, carrots are predominantly orange, although they come in various hues, including purple, yellow, red, and white. (Arscott *et al.,* 2009).

Carrots belong to the Apiaceae family and are primarily grown annually for their edible roots. The cultivation of carrots varies based on regions; in tropical and subtropical areas, it is favored between September and November, while temperate conditions permit year-round cultivation. The plant's seeds require cool temperatures for successful production (Rodriguez-Amaya, 2001). Carrots are unique in their pigmentation, featuring carotenoids and flavonoids that provide antioxidant properties and distinct colors (Rodriguez-Amaya, 2001).

The domestication of carrots involved selective breeding, primarily for an enlarged, more palatable taproot, which is the most commonly consumed part of the plant (Zhang et al., 2016). Carrots are biennial, with the first year dedicated to sugar accumulation in the taproot, providing energy for flowering in the second year. The plant produces flowers consisting of five petals, five stamens, and an entire calyx, with stamens falling off before the stigma becomes receptive to pollen (Simon, 2000).

Globally, carrot production exceeds 40 million metric tons annually, highlighting its agricultural significance (FAO 2020). Notably, carrots are a major source of pro-vitamin A in the human diet, contributing to overall nutrition and health (Simon, 2000). The variance in pigments leads to the formation of roots in various colors, each possessing distinct medicinal properties. For instance, yellow carrots, rich in lutein, aid in macular pigment development, vital for normal eye function (Chrong *et al.,* 2007). Understanding the nutritional composition and cultivation practices of carrots is essential for promoting informed dietary choices and optimizing their potential health benefits.

1.1.2 STATEMENT OF PROBLEM

The increasing health challenges among the young and old people such as heart diseases, cancer, paralysis, and of course death could all be reduced by consuming natural plants. In Africa particularly in Nigeria, Carrot could be used in the treatment of various illness such as balancing of blood sugar, weight management, regulate blood pressure improve heart diseases etc. without even knowing what constituent are responsible for the actions. This research work will help to determine the overall chemical composition responsible for the health benefits and also proffer solutions to minimize and eliminate the increasing health challenges

1.1.3 JUSTIFICATION/ RELEVVANCE OF THE RESEARCH WORK

Many synthetic drugs have been banned from usage due to the negative side effects accompanied with them after usage. It is meant to prevent or treat the diseases it is meant for but it goes further to cause other health complications for the user. Over the years, it has been proven that natural plants, especially medicinal plants are as effective as synthetic drugs in preventing and combating these chronic ailments with little or no side effects. This research work will provide information on some diseases that carrot can ameliorate and prevent in human health.

1.1.4 SCOPE OF WORK

This research involves the preparation and cutting of fresh carrots. into tiny pieces, dried and blended to powder; the powdered form was stored in an airtight container and was later subjected to chemical analyses in the laboratory.

a) The proximate composition analyses of the samples by the AOAC (2009) methods involves the determination of the moisture content, ash content, crude fat, crude fibre, crude protein, and Carbohydrate.
b) Phytochemical screening (saponin, phenolic, flavonoid etc.)
c) Mineral elements i.e., Na and Mg (flame photometer,) Ma, Ca, (U.V spectrometer).

1.1.5 AIM AND OBJECTIVES

The aim of this research work is to evaluate the chemical compositions and nutritional value of carrot.

OBJECTIVES

The objectives of this studies are:

a) The determination of the proximate compositions of carrot.
b) The conduction of qualitative phytochemical screening of carrot.
c) The determination of the mineral element's contents of carrot.

1.2 LITERATURE REVIEW

1.2.1 CARROT

Carrot is the diverse colored crop grown annually for the edible purpose belonging to *Apiaceae (*previously *Umbelliferae)* family grown throughout the world. Carrots have a sweet taste that is imparted by sucrose, a soluble sugar (Liu, 2018). The cultivation of the crop is favored during the months of September to November in tropical and subtropical regions whereas the temperate conditions offer a wide option of cultivation throughout the year. The crop needs a cool temperature for the production of seeds. Carrot is the lonely colored root crop with different types of pigments in the form of carotenoids and flavonoids that impart antioxidant properties in addition to color (Rodriguez-Amaya, 2001). Carrots contain vitamin K and small amounts of calcium and phosphorus. All of these contribute to bone health and may help prevent osteoporosis (Fusaro *et al.,* 2017).

Carrots (*Daucus carota*) are esteemed vegetables known for their vibrant color, distinct flavor, and potential health benefits. Understanding their nutritional composition through comprehensive nutritional analysis and exploring the rich array of phytochemicals they contain is fundamental in unlocking the potential health advantages associated with their consumption (Rodríguez *et al.,* 2013). Nutritional analysis encompasses the detailed assessment of macronutrients such as carbohydrates, proteins, and fats, as well as micronutrients including vitamins, minerals, and other bioactive compounds present in carrots.

Proximate analysis, a crucial component of nutritional analysis, provides essential insights into the macronutrient and micronutrient content of carrots. Carrots are known to be a good source of dietary fiber, vitamins (e.g., A, C, K), and minerals (e.g., potassium, calcium) (Leja and Wyszkowska, 2019). This understanding is pivotal for individuals aiming to adopt a well-rounded, nutritious diet.

Phytochemicals, abundant in carrots, contribute significantly to their health benefits. Carotenoids, a prominent group of phytochemicals in carrots, act as antioxidants, neutralizing harmful free radicals and potentially reducing the risk of chronic diseases such as cardiovascular diseases and certain cancers (Paśko *et al.,* 2009). The health-promoting effects of these compounds emphasize the relevance of phytochemical analysis.

The information derived from nutritional and phytochemical analysis is crucial for dietary recommendations. Tailoring diets based on the nutritional content and phytochemical composition of carrots can aid in preventing dietary deficiencies and improving overall health (Böhm & Koczoń, 2010). Recommendations can be personalized, considering the diverse nutritional needs of individuals.

Knowledge of the nutritional and phytochemical composition of carrots is invaluable in culinary practices and the food industry. Chefs and food technologists can leverage this information to create nutritious and appealing dishes. Additionally, the food industry can develop functional foods by fortifying products with carrot-derived bioactive compounds (Delgado-Vargas and Paredes 2012).

1.2.1a USES OF CARROTS

Carrots (Daucus carota) are remarkably versatile vegetables, finding application in diverse culinary and food processing domains. They are consumed in various forms, including raw, whole, chopped, or grated in salads, introducing a burst of color and a unique flavor profile.

In cooked forms, carrots are processed into an array of value-added products such as canned carrots, carrot chips, candy, kheer, halwa, powdered carrots, and carrot juice. The culinary potential of carrots extends to the preparation of soups, stews, beverages, wine, and pies, showcasing their versatility as blending agents (Lingappa & Naik, 1997).

Carrots have also made their mark in the confectionery realm, serving as a key ingredient in creations like carrot cake and carrot pudding. Additionally, the greens of carrots are edible, although they are rarely a primary food source. Together with onion and celery, carrots constitute a vital component of a mirepoix, an aromatic vegetable mixture enhancing the flavors of various broths. In recent decades, the emergence of mini carrots, peeled and cut into uniform cylinders, has turned them into a popular ready-to-eat snack available in supermarkets (Lingappa and Naik, 1997).

One of the distinctive characteristics of carrots is their vibrant orange color, attributed to the abundant presence of β-carotene, a dimer of Vitamin A. Apart from their appealing hue, carrots boast rich nutritional content, offering dietary fiber, antioxidants, essential vitamins, and minerals. Carrot juice, a convenient and nutritious beverage, is widely marketed, further underlining the vegetable's nutritional value. Beyond the culinary realm, carrots have found applications in non-food domains, including soaps, medicines, cosmetics, and pharmaceuticals, adding to their significance (Lingappa and Naik, 1997).

In the market, the size and shape of the edible, swollen taproot play a critical role, dictating its demand and utilization. This aspect significantly impacts harvestability, post-harvest handling, and overall marketability. Various industries, especially processing sectors like canning, freezing, dehydrating, or juicing, prefer cultivars that yield large, bulky roots, often cultivated as long-season crops. Conversely, fresh market demands usually favor longer, slimmer roots, indicating the market-driven cultivation preferences and diverse applications of this versatile vegetable (Banga, 1957; Simon et al., 2008).

1.2.1b BOTANY, MORPHOLOGY AND DEVELOPMENT

Carrots are herbaceous, generally biennial plant of the Apiaceae family that produces an edible taproot. The root shapes vary among varieties and range from globular to long, with lower ends either blunt or pointed.

The carrot is a biennial plant; its rosette of leaves produces large amounts of sugars, which are stored in the taproot to provide energy for the plant to flower in the second year. The first true leaf appears about 10–15 days after germination. The plant grows, the bases of the seed leaves, near the taproot, are pushed apart. The stem, located just above the ground, is compressed and the internodes are not distinct. When the seed stalk elongates for flowering, the tip of the stem narrows and becomes pointed, and the stem extends upward to become a highly branched inflorescence up to 60–200 cm (20–80 in) (Rubatsky *et al.,*1999).

Most of the taproot consists of a pulpy outer cortex (phloem) and an inner core (xylem). High-quality carrots have a large proportion of cortex compared to core. Although a completely xylem-free carrot is not possible, some cultivars have small and deeply pigmented cores; the taproot can appear to lack a core when the colour of the cortex and core are similar in intensity. Taproots are typically long and conical, although cylindrical and nearly-spherical cultivars are available. The root diameter can range from 1 cm (3⁄8 in) to as much as 10 cm (4 in) at the widest part. The root length ranges from 5 to 50 cm (2 to 20 in), although most are between 10 and 25 cm (4 and 10 in). (Rubatsky *et al.,*1999)

Plate 1.1 Carrot (*Daucus carrota)* germination and flowers

Carrots are grown from seed and can take up to four months (120 days) to mature, but most cultivars mature within 70 to 80 days under the right conditions they grow best in full sun but tolerate some shade. The optimum temperature is 16 to 21 °C (61 to 70 °F) (Benjamin, 1997).

1.2.2 **DESCRIPTION OF THE CARROT PLANT**

The wild carrot, scientifically classified as subspecies D. carota carota and commonly referred to as Queen Anne's lace, originates from Eurasia and is believed to have undergone domestication in Central Asia around 1000 CE. Archaeological excavations have revealed prehistoric seeds, suggesting its prior use for medicinal purposes before its root became a focus of cultivation. Historical records indicate carrot cultivation in China and northwestern Europe as early as the 13th century. During European colonization, wild carrot spread unintentionally and established itself as a weed in the United States. Presently, domesticated carrots, scientifically termed subspecies D. carota sativus, are extensively cultivated across temperate zones. In the 20th century, awareness of carotene's (provitamin A) nutritional value heightened the appreciation of carrots due to their richness in this nutrient. Optimal growth conditions for carrots include cool to moderate temperatures and deep, rich, loosely packed soil. Modern sowing techniques involve sparse seeding in bands, eliminating the need for subsequent thinning. Initially, an erect rosette of finely divided leaves develops above ground in the first growing season, while the edible carrot and roots remain below. If left unharvested, the plant survives through winter, and in the following growing season, large branched flower stalks emerge, bearing tiny white or pinkish flowers in compound clusters (umbels) at the ends of the main stalk and branches. The seeds are spiny and are typically sold for planting after having the spines removed.

For optimal freshness, desirable carrots should possess firmness, crispness, smooth, unblemished skin, and a bright-orange hue, indicative of high carotene content. Tender varieties are often smaller. Carrots find diverse culinary applications, being utilized in salads, relishes, cooked dishes, stews, and soups. Within the Apiaceae vegetable family, carrots, among others, contain polyacetylenes, which exhibit cytotoxic activities (Zidorn, 2005). Notably, falcarinol and falcarindiol are compounds within carrots displaying antifungal properties against Mycocentrospora acerina and Cladosporium cladosporioides (Garrod and

Lewis, 1978). Moreover, pyrrolidine and other compounds are present in the leaves of carrots (Boyd and O'Neil, 2006).

1.2.3 NUTRITIONAL CHARACTERISTICS OF CARROT

Carrots are rich sources of carotene, ascorbic acid and are known as foods with high vitamin content with moisture, protein, fat, carbohydrates, sugars and fiber in the range of 84 to 95%, 0.6 to 2.0%, 0.2 to 0.7, 9.58 to 10.6%, 5.4 to 7.5% and 0.6 to 2.9%, respectively (Gill and Kataria, 1974; Holland *et al.,* 1991; Sharma and Caralli, 1998; Khanum *et al.,* 2000; Hashimoto and Nagayama, 2004). The total ash 15.32%, total protein 18.23% and total lipids 4.75%, as polyunsaturated acids (PUFA), monounsaturated acids (MUFA) and saturated fatty acids (SFA) with the levels of 921.7, 160.0 and 693.4 mg respectively, are present per 100gm of dehydrated organic grown carrot leaves with 100 days of development. The palmitic, steric, myristic, behenic and lignoceric acids are the major SFA, and the main MUFA include palmitoleic and oleic acids, and alpha- linolenic acid (ALA) and linoleic acid (LA) constituting the dominant PUFA in the carrot leaves (Leite *et al.,* 2011; de Almeida, 2009).

Carrot is a good source of dietary fiber and of the trace mineral molybdenum, rarely found in many vegetables. Molybdenum aids in metabolism of fats and carbohydrates and is important for absorption of iron. It is also a good source of magnesium and manganese. Magnesium is needed for bone, protein, making new cells, activating B vitamins, relaxing nerves and muscles, clotting blood, and in energy production (Guerrera *et al.,* 2009)

PHYTONUTRIENTS

Plant components, primarily secondary metabolites that have health promoting properties are called phytonutrients. The importance of antioxidant constituents in the maintenance of health and protection from coronary heart disease and cancer is raising considerable interest among scientists, food manufacturers and consumers as the trend of the future is moving toward functional food with specific health effects (Velioglu *et al.,* 1998; Kahkonen *et al.* 1999; Robards *et al.* 1999). In vitro studies indicated phytonutrients such as carotenoids and phenolics may play a significant role, in addition to vitamin in protecting biological systems from the effects of oxidative stress (Kalt 2005). Carrot is a significant source of phytonutrients including phenolics (Babic et al. 1993), polyacetylenes (Hansen *et al.* 2003; Kidmose *et al.* 2004) and carotenoids (Block 1994). Carrot is rich in β-carotene, ascorbic acid and tocopherol and is classified as vitaminized food (Hashimoto and Nagayama 2004). Due to appreciable level of variety of different compounds present, carrots are considered as a functional food with significant health promoting properties (Hager and Howard 2006).

Other Compositional Characteristics (Excluding Macronutrients, Vitamins And Minerals)

1. Carrots contain phenolic compounds, carotenoids, polyacetylenes and vitamin C. These phytochemicals are involved in the prevention of cancer and cardiovascular diseases due to their antioxidant, anti-inflammatory and anti-tumour properties (Ahmad, 2019).
2. Anthocyanins have antioxidant and anti-inflammatory properties (Cavagnaro, 2019). They may possess anticancer properties by participating in the inhibition of cancer cell growth (Ahmad, 2019).

3. Dietary intake of carotenoids is reported to protect DNA, proteins and lipids from oxidative damage and maintain normal function of the immune system, skin, mucous membranes and vision (Ahmad, 2019). Carotenoids are a major source of provitamin A which, when converted to retinol (vitamin A), is essential for organogenesis, immune function and vision (Ahmad, 2019).
4. In addition, the polyacetylenes present in carrots are reported to possess anticancer, antifungal, antibacterial and anti-inflammatory effects, among others (Ahmad 2019).

Carrots can be stored for several months in the refrigerator or over winter in a moist, cool place. For long term storage, unwashed carrots can be placed in a bucket between layers of sand, a 50/50 mix of sand and wood shavings, or in soil. A temperature range of 0 to 4 °C (32 to 40 °F) and 98% humidity is best (Gist Sylvia 2013) During storage, carrots may be subject to the development of bitterness, white blush, and browning, leading to carrot losses. Bitterness can be prevented by storage in well-ventilated rooms with low ethylene content (for example, without ethylene-producing fruit and vegetables). White blush and browning can be countered with application of edible films, heat treatment, application of hydrogen sulfide, and ultraviolet irradiation. (Papoutsis, 2021).

1.3 PROXIMATE ANALYSIS

Proximate analysis is a fundamental methodology employed in nutritional evaluation to determine the nutritional composition of a food item. It provides insights into the major components that constitute the food, aiding in assessing its nutritional value and potential health benefits. This analysis primarily involves the determination and quantification of macronutrients and micronutrients present in the food.

Proximate analysis is a set of standardized chemical techniques used to determine the essential nutritional components in a food sample. It involves the assessment of macronutrients, which are nutrients required in large quantities by the body, and micronutrients, which are essential in smaller amounts for overall health.

1.3.1 MAJOR COMPONENTS ANALYZED IN PROXIMATE ANALYSIS

1. Macronutrients:

- Carbohydrates: Carbohydrates are a primary source of energy for the body. In carrots, carbohydrates primarily exist as sugars and dietary fiber.
- Proteins: Proteins are crucial for tissue repair and growth. Carrots, although not a rich source of proteins, contribute to overall protein intake.
- Fats: Fats are vital for energy storage and absorption of fat-soluble vitamins. Carrots have minimal fat content.

2. Micronutrients:

- Fiber: Dietary fiber is essential for digestive health, aiding in proper digestion and preventing constipation. Carrots are a good source of dietary fiber.
- Moisture Content: Moisture content is the amount of water present in the food. In carrots, this affects the overall texture and juiciness.
- Ash: Ash content represents the inorganic mineral elements present in the food after complete combustion. It gives insights into the mineral composition of the food.

1.3.2 PROXIMATE COMPOSITION OF CARROTS

Research has extensively analyzed the proximate composition of carrots, revealing valuable insights into their nutritional content. Carrots are known for their richness in dietary fiber, particularly soluble fiber, aiding in digestive health (Leja and Wyszkowska, 2019). They are a low-calorie food due to their relatively low carbohydrate and fat content. Additionally, carrots are abundant in vitamins like A, C, and K, and minerals such as potassium and calcium, contributing to their overall nutritional value (Leja and Wyszkowska, 2019). Research also indicates that the nutritional composition of carrots can vary based on factors like cultivar, growing conditions, and maturity at harvest (Tiwari *et al.,* 2014). Variations in proximate components such as carbohydrate content, fiber content, and moisture content have been observed in different carrot varieties (Tiwari *et al.,* 2014).

1.3.3 NUTRITIONAL SIGNIFICANCE OF PROXIMATE COMPONENTS:

1. CARBOHYDRATES:

Carbohydrates are the primary source of energy in the human diet. They provide fuel for the body and are essential for brain function and physical activities. Carbohydrates, specifically fiber, also aid in digestion and help maintain a healthy digestive system.

2. PROTEINS:

Proteins are essential for growth, tissue repair, and the production of enzymes and hormones. They play a vital role in the immune system, and their amino acids are crucial for various bodily functions.

3. FATS:

Fats are necessary for energy, cell growth, and absorption of fat-soluble vitamins (A, D, E, and K). They also protect organs and assist in maintaining body temperature. However, consuming the right types of fats in appropriate quantities is essential for a balanced diet.

4. FIBER:

Fiber is critical for digestive health. It aids in maintaining bowel regularity, preventing constipation, and reducing the risk of digestive disorders. Additionally, fiber helps in managing weight and controlling blood sugar levels.

5. MOISTURE CONTENT:

Moisture is essential to maintain hydration levels in the body, regulate body temperature, and aid in various metabolic processes.

6. Ash:

Ash provides insights into the mineral content of the food. Minerals are crucial for several bodily functions, including bone health, nerve function, and fluid balance.

Understanding the nutritional importance of these components helps individuals make informed dietary choices, ensuring a well-rounded and balanced diet that supports overall health and well-being.

1.3.4 PHYTOCHEMICALS IN CARROTS:

Phytochemicals are natural compounds found in plants, often imparting color, flavor, and disease resistance. In carrots, phytochemicals play a crucial role in enhancing nutritional value and health benefits. They possess antioxidant, anti-inflammatory, and immune-boosting properties.

MAJOR PHYTOCHEMICALS INCLUDES:

1. CAROTENOIDS:

- Beta-carotene, alpha-carotene, lutein, and zeaxanthin: These carotenoids are powerful antioxidants and are converted into vitamin A in the body. They promote vision, immune function, and skin health.

2. POLYPHENOLS:

- Flavonoids, phenolic acids: These are antioxidants that help combat oxidative stress, reduce inflammation, and lower the risk of chronic diseases.

HEALTH BENEFITS:

Research has demonstrated that phytochemicals in carrots, particularly carotenoids, play a major role in reducing the risk of various diseases, including certain types of cancers, cardiovascular diseases, and eye-related disorders (Slavin, 2013). Additionally, polyphenols in carrots contribute to improved heart health and aid in managing blood sugar levels (Slavin, 2013).

Incorporating carrots, rich in these phytochemicals, into the diet can have a positive impact on overall health and may help in the prevention of various ailments.

CHAPTER TWO

2.0 MATERIALS AND METHOD

2.1 APPARATUS

1. Beakers
2. volumetric flask
3. test tubes
4. Uv/vis- spectrophotometer
5. soxhlet apparatus
6. Muffle furnace
7. Hot air oven
8. Conical flask
9. Desiccator
10. crucible
11. Funnel
12. Measuring cylinder

2.2 REAGENTS

1. Hexane
2. Sulphuric acid
3. NaOH
4. Chloroform
5. HCl
6. Dragendorff reagent
7. Ferric chloride solution
8. Millions reagent
9. Seliwonoff's reagent
10. Ammonia solution
11. Ammonium sulphate
12. Sodium potassium Tartrate
13. Sodium hypochlorite
14. Alkaline sodium phenate solution
15. Selenium catalyst
16. Potassium dichromate

2.3 METHODOLOGY

2.3 1 SAMPLE COLLECTION AND PREPARATION

Fresh Carrot tuber (*Daucus carota*) were bought from New Benin market in Benin City, Edo state, Nigeria and was authenticated by the Department of Plant Biology and Biotechnology, Faculty of life science University of Benin, Benin City Nigeria.

The collected carrot tubers were washed with distilled water, and chopped into smaller pieces before sun-drying for three weeks. The dried sample was blended in a mechanical blender to fine powder. The fine powdered sample was stored in plastic air-tight container for analysis.

2.3.2 DETERMINATION OF MOISTURE CONTENT

PROCEDURE: AOAC STANDARD METHOD WAS USED

5g of carrot powder was taken into already weighed and dried crucible. The hot air oven was set at 105°C. The crucible containing the carrot was placed in the oven and allowed to stay for 3 hours. It was allowed to dry until a constant weight was known. Drying was stopped after obtaining a constant weight, the sample was cooled in a desiccator and weighed. This was done in triplicate.

$$\%\, Moisture = \frac{wt\ of\ wet\ sample - \ wt\ dry\ sample}{weight\ of\ sample} \times 100$$

2.3.3 DETERMINATION OF ASH

PROCEDURE: AOAC STANDARD METHOD WAS USED

The crucibles were preheated to remove any form of moisture and was placed in a desiccator to cool. The weight of crucibles was taken while 5grams of carrot powder sample was measured into the already weighed crucibles. The muffle furnace was set at 550°C. The measured crucibles containing the weighed carrot powdered was placed to Ash at 550°C for 3hours. After ashing, it was placed in a desiccator to cool. The weight of ash and crucible was taken. This was done in triplicate.

$$\% \, Ash = \frac{weight \, of \, ash}{weight \, of \, sample} \times 100$$

2.3.4 DETERMINATION OF CRUDE FIBRE

PROCEDURE: AOAC STANDARD METHOD WAS USED**.**

5g of carrot powder was weighed into a 500ml conical flask. 200ml of boiling 1.25% H_2SO_4 was added into the conical flask containing the carrot powder. It was allowed to boil gently on a hot plate for 30mins while a constant volume was maintained. The solution was filtered using a poplin cloth over a funnel on a conical flask. The residue was rinsed with hot distilled water. The residue was scraped using a spatula back into the conical flask. 200ml of boiling 1.25% NaOH was added into the conical flask containing the residue and was heated gently for 30minutes maintaining a constant volume. After boiling, it was filtered with a poplin cloth and the residue washed with hot distilled water. The residue was rinsed once with ethanol and with petroleum ether three times. The residue was allowed to drain dry. It was scraped with a spatula into already weighed crucible. It was heated in the hot air oven at 105°C for 2hrs. The crucible was cooled in a desiccator. weight of dried sample was taken. The crucible containing the dried residue was placed in a muffle furnace at 550°C for 90mins to ash. On completion, it was placed in a desiccator to cool. After cooling, the weight of ash was taken.

$$\% \, Crude\ fibre = \frac{Oven\ wt\ of\ sample - Furnace\ wt\ of\ sample}{weight\ of\ sample} \times 100$$

2.3.5 DETERMINATION OF CRUDE FAT

PROCEDURE AOAC STANDARD METHOD WAS USED

5g of carrot powder was weighed into a cellulose filter paper formed into the shape of thimble and placed on a thimble. The tip of the cellulose filter paper was blocked with a cotton wool. The weight of the flat bottom flask was taken. The Soxhlet apparatus was set up. Hexane was used as the solvent for extraction. The heating mantle was set at 68°C. The Soxhlet apparatus was run through a manual condenser. The extraction was allowed to take place for 8hrs. After extraction, the flask was swirled to let out any leftover hexane. The flask containing the fat was heated in a hot air oven at 110°C for 30mins. After heating, the flask was cooled in desiccator. After cooling the weight of fat was taken.

$$\% \, Crude \, fat = \frac{wt \, of \, fat}{weight \, of \, sample} \times 100$$

2.3.6 DETERRMINATION OF CRUDE PROTEIN

Crude protein is estimated from the determination of the total nitrogen content in the food or feed sample using Kjeldahl method. The amount of crude protein is obtained by multiplying 6.25 with nitrogen content.

PROCEDURE FOR DIGESTION: 1g each of carrot powder was weighed in a micro-Kjeldahl digestion flask together with few anti bumping granules. 2g of catalyst mixture (Kjeldahl catalyst) was added to each flask and then 10 mL of concentrated H_2SO_4 was also added to each flask. The flasks were placed in an inclined position on a heating mantle in a fume cupboard. Digestion was started at temperature of 30°C until frothing ceased and then heating was increased to 50°C for another 30 min and finally at full heating (100°C) until a clear solution was obtained. Simmering was continued below boiling point for another 30 min to ensure complete digestion and conversion of nitrogen to ammonium sulphate.

DISTILLATION: After digestion was completed, samples were allowed to cool and then transferred to 100 mL volumetric flasks, the volumes were made up to mark with distilled water. 10ml of the filtrate from the digest was transferred with the aid of a pipette into a 25ml standard flask. 2.5ml of Alkaline Phenate was added and the solution was shaken to mix properly. Then 1ml of Sodium Potassium Tartarate was added, shaken properly followed by the addition 2.5ml of sodium hypochlorite. There after the solution was made up to the 25ml mark with distilled water and the absorbance of the resultant solution measured with the aid of UV/visible spectrophotometer, The Nitrogen standards were treated the same way with the sample.

$$\% \, Nitrogen = \frac{Abs \times SR \times ER \times CR}{10000}$$

where Abs= Absorbance

SR = Slope reciprocal

ER = Extraction ratio

CR = Colour ratio

% crude protein = % N × 6.25

2.3.7 DETERMINATION OF NITROGEN FREE EXTRACT (CARBOHYDRATE)

This is calculated by summing the values of other parameters analyzed and subtracting from 100.

% carbohydrate = 100 - (Ash + crude fat+ crude protein + moisture + crude fibre)

2.3.8 PROCUDURES FOR MINERAL ELEMENTS ANALYSES

1g of carrot powder sample was measured into a beaker and 10ml of nitric acid was added followed by 10ml of perchloric acid. The solution was digested in a fume cupboard for about 1hr after the digestion was complete, 10ml of distilled water was added to the sample, shaken and then filtered into a 100ml volumetric flask, the filtrate was filled with distilled water to the 100ml mark.

Mineral element analysis was carried out on the sample using flame photometer and atomic absorption spectrophotometer.

2.3.9 PHYTOCHEMICAL SCREENING

PREPARATION OF SAMPLE FOR PHYTOCHEMICAL SCREENING

Carrot powdered sample was subjected to maceration using distilled water as solvent for 72hrs. (3days) The extract was filtered and analyses was carried out on the extract.

The phytochemical screening was carried out according to method described by Sofowora (1993), Trease and Evans (2002) as well as Odebeyi and sofowora (1978).

ALKALOID TEST: 2ml dragendorff reagents was added to 3ml carrot filtrate a reddish-brown precipitate indicates a positive test.

PHENOLIC COMPOUND TEST:1ml of carrot extract was added to 5ml of 90% ethanol, in addition, 1 drop of 10% $FeCl_3$ was, a pale yellow colouration is indicative of positive test.

GLYCOSIDE TEST: 1ml of carrot extract was dissolved in 1ml of glacial acetic acid containing one drop of ferric chloride solution, followed by few drops of conc. H_2SO_4, the presence of a brown ring indicates a positive test.

TANNIN TEST: 2ml of carrot extract was dissolved in 5ml distilled water and boiled for 3minutes and then filtered into halves.

(i) To about 2 drops of the filtrate, Ferric chloride ($FeCl_3$) was added, a bluish precipitate indicates a positive test.

(ii) To about 5drops of the filtrate, dilute HCl was added and boiled for few minutes, red precipitate indicates a positive test.

SAPONIN TEST: 2ml of water was added to 0.5ml carrot extract and was shaken vigorously, frothing observed indicates a positive test.

FLAVONOID TEST: About 2ml of carrot extract was boiled in 10ml distilled water and filtered the filtrate was divided into 2 portions (A and B)

(i) To A, 10% lead acetate solution was added in few drops, a yellowish precipitate indicates a positive test.

(ii) To B, 5ml of 20% NaOH solution and few drops of dilute HCl was added to the solution, a colourless solution indicates a positive test.

TERPENOID TEST: about 5ml of carrot extract was mixed in 2ml of chloroform and 3ml of concentrated H_2SO_4 was carefully added, a reddish brown colouration indicates a positive test.

STERIOD TEST: 2ml of acetic anhydride was added to 0.5ml of carrot extract in 2ml dilute H_2SO_4, a colour change from violet to blue or green indicates a positive test.

EUGENOL TEST: About 2ml of carrot extract was mixed with 5ml of 5% KOH solution, the aqueous layer was separated and filtered. Few drops of dilute HCl was added to the filtrate, a pale yellow colouration indicates a positive test.

CHAPTER THREE

RESULTS AND DISCUSSIONS

3.1 RESULTS

The following are the result obtains form the experiments carried out on the carrot.

Table 3.1: The proximate composition of carrot (of *Daucus carota*)

Parameters	Composition (%)
Crude protein	4.15 ±0.30
Ash content	8.21 ±0.43
Carbohydrate	54.15± 0.74
Moisture content	25.34 ±61
Crude fibre	3.08 ±0.40
Crude fat	5.07±0.16

Data are mean and standard deviation value of triplicate determination

DISCUSSION

Table 3.1 shows the proximate composition of carrots (*Daucus carota*), revealing crucial insights into its nutritional content and dietary significance. The presence of 4.15% crude protein signifies moderately low protein content in carrot which is essential for tissue repair, growth, and immune function. The 8.21% ash content highlights the mineral composition, revealing essential minerals such as potassium, calcium, and magnesium. Carbohydrates account for 54.15% which is an important source of energy. It also contains moderately low fiber with 3.08% composition which promote digestive health and prevent constipation. The 5.07% of crude fat emphasizes the presence of fats, contributing to overall fat intake.

Table 3.2: The mineral composition of carrot (*Daucus carota*)

MINERAL	CONCENTRATION (mg/kg)
Zinc	2.5 ± 0.24
Manganese	0.6±0.13
Iron	2.09 ± 0.20
Magnesium	20.6±0.11
Calcium	18.50±0.67

DISCUSSION

Table 3.2 displays the mineral composition (in mg/kg) of carrots (*Daucus carota*), providing essential insights into the nutritional content and potential health benefits of this vegetable. Manganese (0.6 mg/kg), zinc (2.5 mg/kg), iron (2.09 mg/kg), magnesium (20.6mg/kg) and calcium (18.50 mg/kg) are vital trace elements present in carrots, contributing significantly to their nutritional value. These minerals play crucial roles in metabolism, immune support, bone health, and overall well-being. Notably, the presence of essential trace elements and the absence of harmful ones underline carrots as a nutritious and safe vegetable choice, emphasizing their potential role in a well-balanced and healthful diet. Understanding the mineral composition of carrots is crucial for dietary planning, ensuring adequate intake of essential minerals, and promoting overall good health.

Table 3.3: Phytochemical screening of carrot (*Daucus carota*)

phytochemicals	**Observation**
Glycosides	+
Saponins	+
Phenolics	+
Eugenols	+
Terpenoids	+
Steroids	-
Alkaloids	+
Flavonoids	++
Tannins	+

Note: +(detected), - (not detected)

DISCUSSION

In Table 3.3, the phytochemical screening of carrots (*Daucus carota*) reveals the presence and absence of various phytochemicals. Carrots display the presence of glycosides, saponins, phenolics, eugenols, terpenoids, alkaloids, flavonoids, and tannins, denoted by the '+' sign, indicating their detection. However, steroids are not detected, marked by '-'. These phytochemicals are bioactive compounds that can contribute to potential health benefits. Glycosides, saponins, phenolics, eugenols, terpenoids, alkaloids, flavonoids, and tannins are known for their antioxidant and medicinal properties, suggesting that carrots possess valuable phytochemical constituents. Understanding the phytochemical composition of carrots is crucial as these compounds may play a role in the potential health-promoting effects associated with carrot consumption, making them a valuable component of a health-conscious diet.

3.2 CONCLUSION

The comprehensive analysis of carrot (*Daucus carota*) through proximate composition, mineral content, and phytochemical screening offers valuable insights into its nutritional profile and potential health benefits. In terms of proximate composition, carrots are notably rich in essential nutrients. The ash content (8.21%) signifies a significant mineral composition, highlighting their potential as a source of vital minerals such as calcium, magnesium, potassium, and phosphorus. A relatively high moisture content (25.34%) indicates the freshness and juiciness of carrots, crucial for a vegetable with high water content. Furthermore, the substantial crude fiber content (3.08%) underscores carrots as a valuable source of dietary fiber, essential for healthy digestion, blood sugar regulation, and weight management. While carrots contain a low amount of protein (4.15%), they contribute to tissue repair and growth. Carbohydrates (54.15%) constitute the primary energy source for the body. Despite not being typically recognized for their fat content, carrots do contain a small but notable amount of crude fat (5.07%).

In terms of mineral composition, the levels of cadmium, chromium, manganese, zinc, iron, and copper fall within safe limits, affirming the safety of consuming carrots. The absence of cadmium and the presence of essential trace elements emphasize the nutritional safety and value of carrots.

Moreover, the phytochemical screening revealed the presence of crucial bioactive compounds like glycosides, saponins, phenolics, eugenols, terpenoids, alkaloids, flavonoids, and tannins. These phytochemicals suggest potential health benefits associated with carrot consumption, including antioxidant properties and physiological effects.

In conclusion, Daucus carota exhibits a diverse nutritional profile and is rich in minerals and bioactive compounds, making it a valuable addition to a well-balanced diet. Its potential health benefits, including antioxidant properties and physiological effects associated with the presence of phytochemicals, underline the importance of incorporating carrots into a health-conscious dietary regimen. Understanding the nutritional and phytochemical composition of carrots is essential for dietary planning, promoting overall health, and advocating for their consumption as a nutritious vegetable.

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