COMPARATIVE STUDY OF ANTIOXIDANT AND PHYSICOCHEMICAL PROPERTIES OF FRESH AND PROCESSED STRAWBERRY

BY

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CERTIFICATION

This is to certify that this project has been read and approved as meeting the requirement of the Department of Nutrition and Dietetics, Institute of Applied Science (IAS), Kwara state Polytechnic, Ilorin for the award of National Diploma (ND) in Nutrition and Dietetics

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DEDICATION

This research project is dedicated to the Almighty God, the most high that be with me throughout my National Diploma (ND) program at the Kwara state Polytechnic, Ilorin and to my beloved parents and guardians who have stood by my side all the time

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Your Glory shall never be shared with any being.

Abstract

Berries are wealthy in compound like phenolic compound and flavonoid that are decided antioxidants and are great important to health. This research was carried out to compare the physiochemical and antioxidant properties of fresh and processed strawberries.

It was evaluated for DPPH which gave 53.23% for fresh 26.98 and for juice, TPC 232.93 for fresh and 224.11 for juice, PH (3.10 and 3.15) for fresh and juice respectively, TTA 0.17% for fresh and 0.05% for juice, Vitamin C 60.16 for fresh and 51.52 for juice. From the result the processing has a high significant on the DPPH reducing the antioxidant capacity, also Vitamin C degraded during juice processing, juice is less acidic from the result and has high titratable acidity. Therefore fresh strawberry retained more Vitamin C and antioxidant than jusice while processing decreases antioxidant potential and increases acidity.

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CHAPTER ONE

1.1. Background of the Study

Fruits are essential components of a healthy diet due to their rich supply of vitamins, minerals, fiber, and phytochemicals — particularly antioxidants. Among fruits, strawberries (Fragaria × ananassa) are highly valued not only for their taste and color but also for their high antioxidant content, including vitamin C, polyphenols, anthocyanins, and flavonoids (Sun et al., 2022). Antioxidants are compounds that protect cells from oxidative stress by neutralizing free radicals, thereby reducing the risk of chronic diseases such as cardiovascular diseases, cancers, and neurodegenerative conditions (Halliwell & Gutteridge, 2021).

However, most fruits, including strawberries, undergo various forms of processing such as drying, juicing, or jam production to increase shelf life, improve accessibility, and reduce post-harvest losses. While processing extends usability, it may alter the nutritional and antioxidant content of fruits (Silva & Oliveira, 2020). Thermal processing methods, in particular, have been shown to degrade heat-sensitive antioxidants like vitamin C, while in some cases, they may increase the bioavailability of other compounds such as certain phenolics (Capanoglu et al., 2021).

Understanding the effect of processing on the antioxidant profile of strawberries is vital, especially in food science and public health contexts. This study aims to compare the antioxidant properties of fresh and processed strawberry samples to determine the impact of processing methods on their nutritional quality.

1.2. Statement of the Problem

While strawberries are widely consumed fresh, their short shelf life necessitates processing into forms like jams, juices, or dried fruits. Although these products are popular, there is concern about the possible reduction in antioxidant levels during processing. Many consumers are unaware of how processing affects the health benefits of strawberries. There is a need to scientifically assess and compare the antioxidant properties of fresh versus processed strawberry to provide informed dietary and processing recommendations.

1.3. Objectives of the Study

The main objective of this study is to compare the antioxidant properties of fresh and processed strawberries.

The specific objectives are:

. To determine the antioxidant levels in fresh strawberry fruits.

. To determine the antioxidant levels in processed strawberry products (log or juice).

. To evaluate the effects of processing on the antioxidant capacity of strawberries.

. To recommend suitable processing methods that retain maximum antioxidant content.

1.4 Significance of the Study

This study will provide valuable insights into how processing affects the nutritional value of strawberries, particularly in terms of antioxidant retention. The findings will be useful to:

- Consumers, for making informed dietary choices.
- Food processors, for improving processing techniques that minimize antioxidant loss.
- Nutritionists and public health workers, in promoting fruit-based diets.

CHAPTER TWO

2.1 OVERVIEW OF STRAWBERRY COMPOSITION AND ANTIOXIDANT PROPERTY

Strawberry (Frangaria x ananassa Duch). are in important crop in certain temperature area, such as central Europe. They are widely consumed, both fresh and in processed forms such as juices,which may further be stored. This attractive fruit are favored for their excellent taste and can be considered a very rich source of bioactive phenolic compound, including: hydroxyainnamic acids, ellagic acid, alagitannins, flavin-3-Ols, flavonoids and anthocyanins (Maata-Rohinen KR, Kamal-Eldin A, Torronen AR 2004) J Agric food chem S2: 6178 - 6187). Compared with other fruit, strawberries, possess high antioxidant activity (Sun J, Ohu Y-F, WUX, Uu RH 2002) J Agric food chem 50:7449 - 7454). Guo et al (Guo C, Coa G, Solic E, Prior RL 1997) J Agric food chem 45:1787 - 1796). Found that strawberry had1.3 times the antioxidant activity of Oranges, twice that red grapes, five times that of apples and bananas, and thirteen times that honeydew. Antioxidants activity of strawberry Phenolic could participate in the prevention of cancer, cardiovascular, and chronic diseases(Hannum SM 2004), Crit Rey food sci 44:1 - 17). Recently, the antioxidant activity of Strawberry extract independence of in uitro anti proliferative activity, as been shown with the use of the HepG2 human liver cancer cells (Meyer KJ,Watkins CB, prints mp, liu RH(2003) J Agric food chem 51: 6887 - 6892). Reduction in antioxidant activity during processing and storage (Lindley MG 19998) may reduce the beneficial effects of such food product in health. Injury of raw material tissue and exposure to oxygen, enzymes, light , and

heat may reduce the antioxidant compound content as well. Strawberry phenolics such as palargonidium ellagic acid, p-coumaric acid, quercetin, and Keampferol derivatives are very unstable and undergo destruction during fruit transformation, especially during the juic and nectar production process.

Previous studies has focused on the free Phenolic contents, and antioxidant activity of strawberry product (Amakura Y, Umino Y, Tsuji S, Tonogai Y 2005). However, Antioxidant can exist in boats free and bound form. Free anthocyanins, hydoxyeinnamic acids, (+) -catechin, and flavonal glycoside do not binds the strawberry cell walls while proanthocyanidins polymers bound selectively to polysaccharide and protein before an example of this in Apple(Renard CMGC, Baron A, Guyot S, Drilleau JF 2001)

Proanthocyanidins are also found in strawberry fruit as procyanidin and propelsgondin derivatives, (+)-catechin and (-)-epicatechin contribute 93.8% of constituent units, which is in an accordance with the predominance of the procyanidins in strawberry (Kelin MA, 2004)

(Herbert et al 2002) suggested that proanthocyanidins content in strawberries can be used to screen gray mold resistance, and can be used to screen strawberry selections and cultivars in order to improve shelf life and quality. The proanthocyanidins are receiving increasing attention owning these of simple monodic league, which may correspond correspond to Health protective action(Hagerman AE 1998) Little is known about the structural features that affects the bioavailability and metabolism of proanthocyanidins within the body(Seno et al 2003) showed that some Oligometric

proanthocyanidins are absorbed and bioavailable in the human body can be detected in human plasma as early as 2hrs after ingestion of grapeseed extract

Antioxidant are a class of chemical substances naturally found in our food which can prevent or reduce the oxidative stress of the physiological system. The body is constantly producing free radicals due to regular use of oxygen. The free radicals are responsible for the cell damage in the body and contribute to various kind of health problems, such as heart disease, diabetes, macular degeneration, and cancer

Antioxidants being fantastic free radical scavenger helps in preventing and repairing the cell damage caused by radical

Plants and animals are the abundant source of naturally producing antioxidants. Alternately, antioxidants can also be synthesized by the chemical process as well as from the different kind of a agro-related wastes using biological process. Based on their solubility, antioxidants are broadly categorized into two groups. Water are soluble and lipid soluble.

Antioxidant add the molecules that prevents cellular damage caused by oxidation of other molecules. Oxidation is a chemical reaction that transfer electron from one molecule to an oxidizing agent. Oxidation reaction are known to produce free radicals. These free radicals are highly reactive species with contains one or more unpaired electron chain reaction starts. Antioxidant reacts with these free radicals and terminate this chain reaction by removing free radical in intermediate and inhibit other oxidation reaction by oxidizing themselves

2.2 PROCESSING OF FRUITS

• CANNING

The temperature and time of heat processing depend on the PH value of the fruit.it is possible to classify fruit to be canned on the basis of acidity and PH value,in general fruit are classified as high acid fruit, while most of the vegetable fall in the category of low or medium acid group.

• DRYING

It is on of the oldest methods of fruit preservation and is widely used.drying usually is accompanied by the removal of water.

• FREEZING

freezing is an accomplished by exposing the fruit to very low temperatures resulting in converting the water molecules of fruit into ice crystals.once the is frozen it has to be stored under very low temperature.

• ADDITION OF SUGAR

the fruit products like jam,jelly,marmalade,candied fruit etc.are preserved by addition of sugar which results in the reduction of available moisture to a level where the development of microorganisms is prevented.

• ASEPTIC PROCESSING

Aseptic processing is the process by which a sterile (aseptic)product (typically fruit or

pharmaceutical) is packaged in a sterile container in a way that maintain sterility.

• ADDITION OF SALT

The concentration of salt necessary to inhibit the growth of microorganisms in fruit is related to many factors,including the water,content,type of infection PH temperate,protein content and presence of inhibitory substance such as acid.

• ADDITION OF ACID

in addition preservation of fruit,aseptic and lactic.acid are most commonly employed.the effects of acid in preventing the development of microorganism may be due to the hydrogen ion concentration.

• CHEMICAL PREVENTION

They are substance capable of inhibiting retarding or arresting the process of fermentation,acidification or other decomposition of fruit .this excludes salt,sugar,organic,acid,spices,alcohol,essential oil and herbs.

• FERMENTATION

Fermentation is a process of anaerobic or partially ,oxidation of carbohydrates.sodium chloride is useful in a fermentation process of fruit by limiting the growth petrefactive organisms and by inhibiting the growth of large number of other organisms.

2.3 EFFECT OF PROCESSING OF FRUIT

Processing of fruits, involve heating different energy transfer media such as water, air, oil, and if it electromagnetic wave. In addition, storage can be classified as passive processing with no energy applied directly to foods. Polyphenolic compounds, including anthocyanins and proanthocyanidins are not completely stable doing

processing (Talcoft et al 2008) physical and biological factor such as temperature increase and enzymatic activity may result in destruction of phenolic antioxidants such as phenolic acid and anthocyanins. After harvest, these compounds can change during food processing and storage (Kader et al, 2002) which may reduce related bio activity during processing of food, various, transformations of phenolic occur to produce yellowish or brownish pigment (Clifford, 2002). The following section discusses the effects of important food processing operation on the photochemical of fruits vegetables and grains.

*** Blanching**

Blanching Ian important full processing step applied to soften the product, as well as to activate the exams that otherwise could cause brownie or other possible reaction in fruit and fruit vegetables. Final compound are degraded by a number of enzymes found implant tissue, such as glycosides, polyphenoloxidase (PPO), and peroxidases. Glycosidases provide anthocyanidins and sugars, and anthocyanidins are very unstable and rapidly degraded. PPO catalyzes the oxidation of O-dihydrophenols to O-quinones that further react to brown polymer, the effectiveness of blanching is indicated by the complete inactivation of peroxidase

*** Cooking/ thermal processing**

Cooking of fruit has mixes effect of phenolic antioxidants of cooked fruit, for

example example, (Sablani el al, 2010) reported that Canning of strawberries (1000°C, 28 minutes) and blueberries (1000°C, 22 minutes) increases the phenolic content and antioxidant activity by 50% and 53% respectively.

*** Drying/Dehydration**

Drying/dehydration is one of the oldest techniques of preserving foods for future with these techniques. Water is removed to reduce water activity that diminishes de bacteria activity in the dried/dehydrated fruit. In addition to the safety of fruit, during preservation, many resource researches focused on the changes of phytochemical during dehydration (“Thiessan” and “Smoky” cu) processed you freezer dry and vacuum microwave drying cause reduction in the total phenolic, antioxidant activities and anthocyanins contents as compared with fresh frozen berries (Knok et al, 2004)

*** Extrusion**

Extrusion cocaine is a high temperature short time, continuous process English food, materials, and plasticized abd cooked by the combination of temperature under pressure and mechanical shear, resulting in molecular transformation and chemical reaction in the processed fruits. Extrusion cooking increases the phenolic content of oats (Zielinski et al, 2001), Cauliflower by product (Stojceska et al, 2008).

*** Irradiation**

Irradiation is aimed to

1. Preserve fruit by destroying or inactivating organisms that cause spoilage
2. Sterilize for storage without refrigeration
3. Provide an alternative to chemical use to control, sprouting, ripening , and insect damage being a cold process, it is important to study the impact of irradiation on the structure and function of phytochemical in irradiated fruits.

2.4 NUTRITIONAL COMPOSITION OF STRAWBERRY

Strawberries represent a healthy food choice. Strawberries contain 80 - 90% water, 0.9 - 1.2% fiber, 4.5 - 10% sugar, 0.17 - 25% tannins (Galoburda et al 2014). Strawberries contain 97% edible portion total soluble solid (7 - 10 - 2°B) titratable acidity(0.52 - 2.26%) protein(0.67g/100g), ash (0.40g/100g], total lipids [0.30 g/100g], Carbohydrate (7.68g/100g) dietary fiber [2g/100g], sugars [4.89g/100g], Vitamin C[58.8mg/100g], Folate [24g/100g) and it exhibits low calorific value of 32kcal/100g of edible protein I.e they are low in total calories with 100g serving provide only 32 kcal(Giampieri et al, 2012) strawberries also contain a range of powerful antioxidant including anthocyanins, ellagic acid, quercetin and Keampferol

***Healtg benefits of strawberry:** strawberries, provide a range of potential benefits that can support our body against a veriety of disease. Some of the benefits are:

• The flavonoid quercetin is present in strawberries, which is natural anti-inflammatory that we reduce the risk of athlerosderosis

• The anthocyanins in strawberries, reduces the risk of heart attack(Myocardial infarction) the fiber and potassium content and strawberry also support heart health

• The powerful antioxidant and strawberries, work against free radicals, which inhibit tumor growth and also decrease inflammation in the body

• Due to the presence of high poly phenol contents, strawberries, have a preventive effects against the heart disease.

• Due to high potassium content, strawberries, provide benefits to people who have raises risk of high blood pressure by helping offset the effects of sodium in the body

• strawberries are helpful in maintaining the regular bowel movements, and also help to hydrate the body due to the presence of high water content and fiber

• strawberries, provide a potential contribution to the dietary management of hyperglycemia liked to type-2 diabetes and related complication of hypertension.

2.5 TYPES OF FRUITS

1. **Canned fruit:** In this method,fruit pieces/slices are placed in cans and covered and cooled .the most popular canned product are pineapples,litchi,mango-slices etc.

2. Dried fruit : In case of drying fruit original water content is removed either through exposure to sun or mechanical drying.the quality of dry fruit can be improved by exposing it to sulphur fruit before drying.the most popular dry fruits are raisins,dates etc.

3: frozen fruit: Fruit are frozen in syrup containing ascorbic acid to prevent browning induced by the enzymes.quick freezing is the best method to retain the quality of the

fruit are acceptable in the frozen form.

4: fruit/beverages: This is a natural juice extracted from the juice and remains practically unwanted in its composition during its preparation and preservations.

5: Fruit juice concentrates: A fruit juice concentrate is prepared by removing moisture by vacuum concentration or by freezing.

6: Fruit juice powder: Fruit juice can be converted into a free flowing highly hygroscopic powder by puff-drying freeze drying,vacuum drying or drum drying.

7: Jam: Jam is prepared by boiling the fruit pulp (45kg)with sufficient quality of sugar (55kg)to a reasonable thick consistency,firm enough to hold fruit tissues in position with the help of pectin.

8: Jelly: A jelly is a semi-solid product prepared by boiling a clear fruit extract free from pulp containing pectin with addiction of sugar and acid.

9: Marmalade: Marmalade is a fruit jelly in which slice of the citrus or its peels are suspended.

10: Candied fruit: A fruit impregnated with cane sugar or glucose syrup and subsequently drained free of syrup and dried,is known as candied fruit.

CHAPTER 3

3.1 MATERIALS

Strawberry, Refractometer, Disposable pipette, PPM, Beaker, Burette, Pipette, Indicator, Blender, Sieving cloth, Water

3.2 SAMPLE COLLECTION & PREPARATION

3.2.1 Collection of sample: Strawberry was bought at the gate of KWARA State polytechnic Ilorin while materialand reagent used for the study are of analytical grade, and it was supplied by the department of nutrition and dietetics and technology KWARA state and some were purchased from laboratory.

3.2.2. Preparation of Strawberry

SAMPLE PREPARATION

Approximately 100g (97.08g of room temperature sample; 97.07g of refrigerated sample; and 97.09g of frozen sample) were blended with 150ml of distilled water separately using high powered (heavy duty) full nutrition blender (SAMSUNG MODEL 2022L)

The resulting puree of each sample was carefully filtered using clean cheesecloth to obtain a clearer solution and the residue collected separately.

Only the good Strawberry (based on physical inspection) while some was peeled and

some wasn’t peeled were taken from each group, washed and drained before blending. The filtrate obtained from each sample was employed for all the analysis carried out. However, the residue was used along with the filtrate in the determination of lycopene and β-carotene.

3.3. DESCRIPTION OF PROCESSING METHOD

Strawberry was Fisrt thoroughly watched and was leaves for sometimes to dry. The strawberry fruit were divided into two parts while some was Peeled and are unpeeled. Strawberry was milled in a blender. With 100ml/s of water to rinsed the blender to filtered out the particles present in it, and then package in a clean bottles.

3.4. Laboratory analysis of antioxidant

DETERMINATION OF BRIX

The percent brix (%brix) content of each fruit juice was determined with the aid of the hand-held refractometer. The value for each sample was read directly from the instrument after placing two drops of each juice sample on the viewing window.

MEASUREMENT OF TOTAL DISSOLVED SOLID (TDS)

About 100ml of the filtrate from each of the samples were measured into a clean 150ml glass beaker. A handheld TDS meter (HANNAH Instruments) was carefully inserted, ensuring that the probe was completely submerged in the liquid. The instrument was left in the sample until a stable reading is obtained in part-per-million (ppm). The reading was taken in triplicate and recorder for each sample.

PH MEASUREMENT

The acidity or alkalinity of each juice sample was established using the table top pH meter (Searchtech instrument model pH5-3C). The values were taken after allowing the probe to equilibrate, giving a stable value.

The pH value of the obtained filtrate from each sample was read directly using a pH meter.

The instrument was initially calibrated with pH buffers 4.0, 7.0 and 9.0. The measurement was done in duplicate for each sample. The pH value was recorded as the longest stable reading on the pH Scale.

DETERMINATION OF TOTAL TITRATABLE ACIDITY

The TTA was determined based on citric acid which is the most abundant acid in tomato. 10ml of the filtrate from each tomato sample were diluted with another 10ml of distilled water in a 250 ml capacity Erlenmeyer flask to make the phenolphthalein endpoint readily visible. To the mixture was added 2-3 drops of phenolphthalein indicator and was titrated against a 0.112M sodium hydroxide (NaOH) solution to a permanent faint pink endpoint. Replicate measurements were carried out. The TTA% was calculated as follows.

The equivalent weight of citric acid is calculated by dividing its molecular weight (192.12g/mol) by the number of titratable hydrogen ions (in this case 3 according to the

chemical structure). Therefore, the equivalent weight of citric acid is 64g/equivalent,

DETERMINATION OF VITAMIN C CONTENT

The vitamin C in each sample was determined iodometrically (i.e. by titration with iodine).

Vitamin C (ascorbic acid) is an antioxidant that is essential for human nutrition. Vitamin C deficiency can lead to a disease called scurvy, which is characterized by abnormalities in the bones and teeth. Many fruits and vegetables contain vitamin C, but cooking destroys the vitamin, so raw fruits and their juices are the main source of ascorbic acid for most people.

Vitamin C Determination by Iodine Titration

One way to determine the amount of vitamin C in food is to use a redox titration. The redox reaction is better than an acid-base titration since there are additional acids in a juice, but few of them interfere with the oxidation of ascorbic acid by iodine.

Iodine is relatively insoluble, but this can be improved by complexing the iodine with iodide to form triiodide:

$$I_2 + I^- \leftrightarrow I_3^-$$

Triiodide oxidizes vitamin C to form dehydroascorbic acid:

$$C_6H_8O_6 + I_3^- + H_2O \rightarrow C_6H_6O_6 + 3I^- + 2H^+$$

As long as vitamin C is present in the solution, the triiodide is converted to the iodide

ion very quickly. However, when all the vitamin C is oxidized, iodine and triiodide will be present, which react with starch to form a blue-black complex. The blue-black color is the endpoint of the titration.

This titration procedure is appropriate for testing the amount of vitamin C in vitamin C tablets, juices, and fresh, frozen, or packaged fruits and vegetables. The titration can be performed using just iodine solution and not iodate, but the iodate solution is more stable and gives a more accurate result.

Procedure

The first step was to prepare the solutions.

Preparing Solutions

1% Starch Indicator Solution

1.00 g of soluble starch was weighed and dissolved in 10 ml of distilled water. 90ml of distilled water was subsequently heat to boiling and quickly added to the suspension of the soluble starch in distilled water in a 250 ml capacity beaker. The content of the beaker was mixed well and allowed to cool before use.

Iodine Solution

5.00 g potassium iodide (KI) crystals and 0.268 g potassium iodate (KIO_3) were dissolved in 200 ml of distilled water. 30 ml of 3 M sulfuric acid was added. The mixture was poured into a 500 ml volumetric flask and diluted to a final volume of 500

ml with distilled water. The solution was mixed well by inverting the stoppered volumetric flask severally. The solution was transferred to an amber bottle and stored away from direct sunlight and labeled as iodine solution.

Vitamin C Standard Solution

0.50 g of vitamin C (ascorbic acid) powder was dissolved in 100 ml distilled water.

Standardizing Solutions

10.00ml of vitamin C standard solution was pipetted into a 125 ml Erlenmeyer flask. Between 7 to 10 drops of 1% starch solution were added and titrated against the iodine solution from a burette. The volume of the iodine solution required to reach a faint blue-black endpoint that persists more than 20 seconds of swirling the solution was recorded. The titration was repeated at least twice to obtain results which agreed within 0.20 ml.

Titration of Vitamin C in samples

The samples were titrated exactly the same as the standard. 10.00 ml of each sample filtrate was pipetted into a 125ml Erlenmeyer flask, 10.00 ml of distilled water was added and the content titrated against the iodine solution from the burette to a faint blue-black endpoint that persisted more than 20 seconds of swirling the solution and the volume recorded. The titration was repeated at least twice to obtain results which agreed within 0.20 ml.

Knowing the volume of iodine solution required for a known amount (in mg) of vitamin C in the standard, this was related to that in the samples to calculate the amount of the vitamin C in each of the tomato samples.

DPPH antioxidant capacity determination

5.00g of each sample was blended with 50ml of methanol and filtered. 2.5ml of the filtrate was measured in a test tube and 1ml of DPPH solution was added. This was left for 30min at 100m temperature in the dark. Subsequently, measurement of the absorbance of the solution was done at 517mm. a blank measurement was also done at the same wavelength.

A solution of ascorbic acid was used as standard for the DPPH measurement 0.1g of ascorbic acid was dissolved and made up to 10ml solution with distilled water 2.5ml of the standard measured into a clean test tube, 1ml of DPPH solution was added and kept for 30mins before absorbance measurement at 517nm was read

% DPPH antiradical Activity

A control sample was determined by adding 1ml of DPPH solution to 2.5ml of water, kept in the dark for 30mins and absorbance measured at 517nm ($Ab_{control}$).

DETERMINATION OF TOTAL PHENOLIC CONTENT (TPC)

To 1ml of methanolic extract solution of each vegetable sample, 5ml of 10% Folin-Ciocalteu reagents (FCR) in distilled water was added and 4ml of 7% $Na2C0_3$ solution. The mixture was incubated at 40’0 for 80mins and the absorbance at 760nm was measured. A blank measurement was also carried out by adding 1ml of methanol to 5ml of FCR and incubated at 40^0c, following the same procedure as for sample.

C = Concentartion of Gallic Acid equivalent obtained from calibration curve.

V = Volume of extract solution

M = Mass of extract in g.

Measurement of TPC of standards for calibration curve

Gallic acid was used as standard for the TPC measurement, six (6) standard solutions were prepared by serial dilution; 0mg/m (blank), 25µg.ml, 50µg/ml, 75µg/ml, 100µg/ml, 125µg/ml and 150µg/ml of GA (Galic acid). 1ml of each solutions was measured into a clean test-tube, then 5ml of 10% folon –Grocalteu reagent (FCR) was added and mixed gently and 4ml of 7% Na_2C0_3 was added subsequently. A blue coloration developed immediately in each test tube. The mixture was incubated for 30mins at 40^0C. A blank test solution was carried out by adding methanol.

CHAPTER FOUR

4.1 RESULTS

Parameters	Strawberry fresh	Strawberry juice	MSE	Sig.
Vitamin C	60.16[a]	51.52[b]	18.78	0.000
DPPH	53.23[a]	26.98[b]	15.37	0.000
TPC	232.93[a]	224.11[b]	76.22	0.000
pH	3.10[b]	3.55[a]	1.12	0.000
TTA	.017[b]	0.05[a]	0.01	0.000

Antioxidant Properties

Parameters	Unpeeled	Peeled
TPC	232.93mg.g -1	224.11mg.g -1
DPPH	53.23%	26.97%

Physicochemical Properties

Parameters	Unpeeled	Peeled
PH	3.1	3.55
TTA	0.17%	0.05%

4.2 DISCUSSION

•Antioxidant properties

The study showed that Vitamin C decreased significantly during juice processing, likely due to oxidation from exposure to air, heat, and light (Davey et al., 2000).

Phenolic compounds are a big class of phytochemicals that exist as secondary metabolites present in crops. Most of them are phenolic acids, flavonoids, and tannins in human food. Besides contribution to sensory properties of food. Phenolic compounds also have a broad variety of biological and physiological tasks, similar to antiallergenic, anti-inflammatory, antimicrobial and antioxidant operations that benefit human health (Balasundram et al., 2006)

The study showed gave 232.93 mg.g-1and 224.11mg.g-1 for fresh and juice straw berry respectively

indicating that the TPC reduced slightly but significantly, consistent with phenolic degradation in juice processing (Patras et al., 2010).

Antioxidant can be widely described as any drug that retards or inhibits a target molecule's oxidative harm (Yamagishi and Matsui, 2011) and prevent biological molecules such as proteins, lipids, and other molecules from oxidation by reactive oxygen species (ROS) such as hydroxyl radical (OH•), hydrogen peroxide (H2O2), superoxide (O2•−), etc. (Brindza et al., 2019). These reactive oxygen species are produced in the body either as a by-product of normal cellular aerobic respiration or exposure to environmental factors such as herbicides, radiation, pollution, and cigarette smoke (Alam et al., 2019). antioxidant's primary characteristic its capacity to intercept free radical. Antioxidant compounds such as phenolic acids, polyphenols and flavonoids scavenge free radicals and prevent the oxidative harm resulting in many illnesses (Wu et al., 2011). A great cause of antioxidants is vegetables and fruits.

the result from this study showed 53.23 %and 26. 97% of the scarveging activity for fresh straw berry and straw berry juice respectively indicating that the DPPH values reduces to halved after juicing, showing substantial antioxidant loss, possibly from degradation of anthocyanins and polyphenols during mechanical and thermal processing.

Physicochemical properties

From the research the fresh strawberry had PH of 3.1 for fresh strawberry and 3.55 PH for the juice

indicating that the pH increased in juice (less acidic), potentially due to dilution or removal of organic acids.

The measurement of titratable acidity allows the quantification of organic acids present in strawberry samples.These organic acids are metabolic intermediates that influence microbial growth and shelf life. The TTA had .017% and 0.05 respetively for fresh strawberry and the juice suggesting that TTA is increased in juice, possibly due to the breakdown of pectin and release of bound acids during blending.

CONCLUSION

Berry fruits contain large quantities of phytochemical compounds (phenolic compounds, flavonoids and tannins) that act as antioxidants. From this resaerch the fresh straw Berry gave more of vitamins C than the juice, the antioxidant was reduce to halve of it value in the juice, Fresh strawberries retain more vitamin C and antioxidant activity than juice.Processing increases acidity but decreases antioxidant potential.

Therefore Minimizing Processing Time for strawberries will help preserve vitamin C and antioxidants also the consumption fresh fruit rather than processed or juice forms will maximum phytonutrient.

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