International Journal of English Literature and Social Sciences
Vol-8, Issue-3; May-Jun, 2023
Peer-Reviewed Journal

Journal Home Page Available: https://ijels.com/
Journal DOI: 10.22161/ijels

Proximate Analysis of Enhanced Coffea canephora var with endemic floral species

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Received: 06 May 2023; Received in revised form: 06 Jun 2023; Accepted: 14 Jun 2023; Available online: 21 Jun 2023

Abstract— *This study focused on examining the proximate analysis of Coffea Canephora var that was enhanced with endemic floral species. The physico-chemical analyses conducted revealed that Solanum nigrum enhanced coffee had a moisture content of 13.42%, crude fat of 2.47%, crude protein of 15.12%, ash content of 6.35%, and a total carbohydrate content of 64.52% (w/w) with 348 Kcal energy per serving. Similarly, Colocasia sp. cf. Formosana hayata enhanced coffee had a moisture content of 12.15%, crude fat of 3.03%, crude protein of 11.29%, ash content of 6.68%, and a total carbohydrate content of 68.86% (w/w) with 355 Kcal energy per serving. Furthermore, enhanced coffee with Momordica charantia had a moisture content of 10.01%, crude fat of 1.41%, crude protein of 13.78%, ash content of 6.46%, and a total carbohydrate content of 70.39% (w/w) with 356 Kcal energy per serving. It was showed that three enhanced coffees had an average energy intake of 3%, which can supplement the Required Energy and Nutrient Intake of an adult Filipino. The study results can provide a low-fat enhanced and enriched coffee in the Kalinga table, as presented in its nutrition facts. However, further investigation is required to determine the safety and microbiological quality of enhanced coffee with floral species, particularly in the quantification of amino acids, vitamins, and minerals. Additionally, it is recommended to investigate the acceptability, market analysis, and utilization of locally grown and traditionally used plant species that could enhance and enrich coffee to meet the country's demand.*

Keywords— ***Coffea canephora, moisture content, floral species, nutritional facts.***

I. INTRODUCTION

1.1 Rationale

Recent study on the organolytic evaluation of Coffea canephora or robusta enhanced with three (3) floral species of solanum nigrum (locally termed am-amti) var,colocasia sp.cf.formosana hayata (pikaw) , and momordica charantia leaves (parya balang) have been undertaken during the fiscal year 2021. The findings shows a moderate acceptability in terms of the parameters on taste ,aroma and degree of preference. Basing from recommendations and findings of the former research, have prompted the proponents to present the chemical assay as deemed necessary since it is considered " food".

This study entitled " The Bio-Assay and Proximate Analysis of Pikaw, Parya balang and am amti looks into the importance of proximate analysis to something taken in into the body as in the case of beverages, food , pastries, breads and the like since the analyses allows one to make legitimate comparisons on the basis of specific nutrients .The process is made mandatory for the standardized nutritional labels to contain and present content information on the following five constituents - protein, fat, moisture, ash and carbohydrates, where the constituents themselves are known as "proximates" and the process of determination of their contents.

Proximate Analysis stands for a method, determines the values of the macronutrients in food samples. In general, those values are being declared as nutritional facts shown usually on the labels of the final (end) food products, but they are also being determined during the production process. The beginning of the nutritional analysis originates back in 1861 and since then it has been continuously developed, modified and improved. This study investigated the Proximate analysis of the three (3) floral species of *Solanum nigrum* (locally termed am-amti) var,*Colocasia*

sp.cf.*Formosana hayata* (pikaw) , and *Momordica charantia* leaves (parya balang) with ground *Coffea canephora* or robusta.

1.2 State of the art

In spite of the fact that coffee production and exports in the Philippines are low, the country is still an important coffee market. It was a pioneer as an instant coffee importer in 2011 and is predicted to become one of the largest consumers of instant coffee at the global level by the end of 2021. The strong demand for instant coffee has further increased the opportunity for many businesses in retail. Policymakers are engaged with stakeholders in order to help domestic producers take advantage of both the local and international markets and facilitate economic up-gradation. Hence, to gain traction from abroad, it becomes necessary to improve the coffee quality of the Philippines through the process and product upgrading. Additionally, the strong local demand has further led to encouraging the government to strengthen the coffee sector in the country.

Furthermore, coffee retail brands like Starbucks, the Coffee Bean & Tea Leaf, and UCC have set their bases throughout the country. This is further providing an impetus for the market to thrive in the forecast period. Additionally, with the emergence of small and independent coffee shops in the Philippines, the market is poised to grow at a significant pace along with rising coffee demand over the next five years.

This discussed that the demand is high but the supply is low thus it is in consideration that this study was conducted to expedite the low produce we are experiencing by developing an enhanced coffee.

1.3 Analysis of the Problem

The presence of big companies like Nestle is contributing to the market's growth offering a wide range of soluble coffee products in order to satiate the coffee needs of the Filipinos. Nescafe Classic, Nescafe Classic Decaf, Nescafe Classic Strong, Nescafe Gold Blend, Nescafe Gold Cappuccino, NESCAFÉ® Blend & BrewTM Original, NESCAFÉ® Blend & BrewTM Strong, and many more are available under the Nescafe brand. One of its products, Nescafe Classic, is available in 2 grams, 25 grams, 50 grams, 100 grams, and 200 grams. It is made from Robusta coffee beans. The company is the biggest buyer of Robusta beans in the Philippines. Considering the dilemma that we are facing and asnwers yet to be sought in raising the supply of coffee in the country, this study infused natively produced floral species available in the locality to enhanced the traditionally brewed coffee along with its nutritive constituents with the goal of savoring the natural aroma of coffee and acquire the nutrients these floral species can provide.

A. Significance of the Study

The present study aims to determine the proximate analysis of Enhanced Coffea canephora var with endemic floral species for providing additional coffee variation enriched with nutrients available from *Solanum nigrum* (locally termed am-amti) var,*Colocasia* sp.cf.*Formosana hayata* (pikaw) , and *Momordica charantia* leaves (parya balang) . The study would be the stepping stone of research that aims to promote, convert and invent natural products by maximizing the use of *Solanum nigrum* (locally termed am-amti) var,*Colocasia* sp.cf.*Formosana hayata* (pikaw) , and *Momordica charantia* leaves (parya balang).

B. Scope and Delimitation of the Study

This study specifically focused to determine the proximate analysis of Enhanced Coffea canephora var with endemic floral species for future natural product development.

II. REVIEW OF LITERATURE

The study of Gaibor et al on the analysis of caffeine content of two canton varieties of coffea ganephora or locally termed caluma and echeandía's present values range of 0.445-2.182% using the UHPLC method. The v alues obtained with the Soxhlet method were of 0.625-2.150%, standard deviation value were higher than the ones using the UHPLC method. This indicates that the precision and exactitude of the UHPLC method is more accurate. These shows that robusta coffee from Ecuador shows a lower caffeine content compared to arabica coffee which is generally the more appreciated in the markers for their organoleptic properties than robusta coffee. While Arabica plants are delicate and are grown at elevations between 600-2000 m.; robusta plants are more hardy, higher yielding and can be grown at lower altitudes of 2,27, 200-800 m.

Robusta coffee in this study was cultivated in an altitude between 1400-1800 m a.s.l and the Concentration of phytonutrients in the plants depend of soil, water and nutrients. These phytonutrients can vary depending on the agronomic and environmental conditions of the cultivar (genetic factors, altitude, temperature, hydric conditions, fertilization and maturation of beans). It is known that parameters as altitude and temperature can affect the caffeine content .

Coffea canephora (robusta) was reported with a caffeine content of 2.6% in green beans of coffee. The caffeine content with a value of 0.445% is lower than in coffea Arabica which 0.583% .This low value of caffeine content allows the use of robusta coffee in the production of decaffeinated coffee as norms indicate a content lower of 1.0% of caffeine as measured using RP-UHPLC and soxhlet

. This study shows consistently , that of the many varieties of coffea ganephora (robusta) and coffea Arabica, It is always coffea ganephora (robusta) that showed a lower caffeine content as compared to coffea Arabica from using the methods of soxhlet, UHPLC method and chromatographic method. Further , as the coffee is roasted , the variety coffea canephora grown in Ecuador in the cantons of Caluma and Echeandía show low percentages of caffeine than coffea arabica. Two analytical methods were used to determine the caffeine content from 8 locations in the 2 cantons. The best results were the ones obtained with the UHPLC method due to its high reproducibility and low differences between the results.

Robusta roasted coffee had a low concentration of caffeine that suggests that this species could be used to make decaffeinated or low-caffeinated beverages however there was no sensory analysis work carried out to determine the consumer acceptance.

From the above information, this study entitled "Organolytic Evaluation of Enhanced Coffea canephora var with endemic floral species" uses the basic elemental procedures the sensory organolytic evaluation before looking into the bioassay or proximate analysis of the experimental products after all the raw materials are combined.

The study of Seninde et. al from the Center for Sensory Analysis and Consumer Behavior of Kansas State University (KSU) based in Manhattan ,USA shows that the sensory characteristics of brewed coffee can be attributed to their non-volatile and volatile compounds (e.g., pyrazines and pyridines that are produced during all phases of coffee production including growing, fermentation, roasting, and brewing processes. Arabica and Robusta green beans have different chemical compositions and consequently varying flavor profiles when roasted.

Green and roasted Robusta coffee beans have a higher chlorogenic acid content than corresponding Arabica beans. For example, Chlorogenic acids such as the feruloylquinic and caffeoylquinic acids found in Robusta roasted beans are 1.5 to 2 times higher in concentration as compared to those in arabica beans . During the coffee roasting process, the total chlorogenic acids are reduced to about 50% at the medium roast level and to small quantities at the dark roast level . Chlorogenic acids contribute to the bitter taste, acidity, and astringent flavor of the coffee when it is brewed. Additionally, chlorogenic acids act as precursors to the formation of phenols and catechols.

During the coffee roasting process, the initial drying phase is mainly characterized by small endothermic reactions which lead to loss of free water, browning, and increase in volume. The moisture content of the roasted coffee ranges from 1.5% to 5% and this depends on the roasting degree attained. The sucrose in the beans caramelizes when their internal temperature reaches 130 °C which explains the yellowish color of the beans. With the bean temperature increasing beyond 160 °C, the color changes to light brown, and the beans further increase in volume . The flavor formed is a result of the endothermic and exothermic reactions when the coffee beans reach a temperature of about 190 °C. Some of the free amino acids and peptides are used in the Strecker degradation process while other amino acids and sucrose are involved in the Maillard reactions, and this results in the bean color change from light brown to almost black. At this point, air or water is used to rapidly cool the coffee beans and consequently stopping the exothermic reactions.

Various compounds impact the bitterness of the coffee brew. Caffeine, a methylxanthine, is heat stable and has bitter sensory characteristics. Roasted Robusta beans contain two times the caffeine concentration contained in Arabica beans .This accounts for a large proportion of the higher bitterness usually found in coffee brews made from Robusta beans.

Trigonelline, an alkaloid, also contributes to the bitterness of coffee brew. Unlike caffeine, trigonelline is degraded during roasting and produces nicotinic acid and other volatile compounds such as pyridines and pyrroles .

Trigonelline and proteins are broken down through Maillard reactions with sugars that are present in green beans to produce volatile compounds such as pyridines, pyrroles, and pyrazines. The pyrazines, pyrroles, and pyridines are responsible for aroma attributes such as nutty, roasted, and toasted notes in the coffee aroma .

This current study entitled "Organolytic Evaluation of Enhanced Coffea canephora var with endemic floral species" uses the basic elemental procedures of sensory organolytic evaluation before looking into the bioassay or proximate analysis of the experimental products after all the raw materials are combined.

The subsequent phase of the above study shall look into the caffeine content, anti-oxidant substances or the general chemical contents when thoroughly mixed with grind coffea ganephora by endemic local floral species found in the province.

Below are previous catalogues of edible floral species which have semblance of bitter taste of coffea ganephora . On that note, the bitter taste could be attributed to its alkali / basic properties to the possible acidic contents of caffeine and anti-oxidant chemicals or substances in coffea ganephora. The study of Akubugwo et. al on the Nutritional Potential of the Leaves and Seeds of Black NightshadeSolanum nigrum L. Var virginicum from

Afikpo-Nigeria (Am-amti) had been assessed to have protein content of the leaves and seed as 24.90% and 17.63% respectively.

Other findings on the ash contents are 10.18% and 8.05% respectively for two samples of solanum nigrum var, crude fibre of 6.81% and 6.29 and carbohydrate of 53.51 and 55.85% for the leaves and seed respectively.

Mineral analysis revealed the order of the following : Mg>K>Ca>Fe>Na>Mn>Zn in the leaves and Mg>K>Fe>Ca>Na>Mn>Zn in the seeds. Phosphorus and sulphur levels were 75.22 and 8.55 mg/100g in the leaves and 62.50 and 14.48, g/100g in the seeds. Vitamin content indicate the order vit C>vit B,>Folic acid>Vit E>Vit A in both the leaves and seeds.

Phytochemical analysis revealed high oxalate, phenol but low sterol content in the studied plant materials.

Cyanide levels were higher in the leaves compared to the seeds. These results suggest that S. nigrum L. Var virginicum to be nutritive despite the presence of some anti-nutritive components like oxalate.

S. nigrum is a good source of energy. Mineral element analysis show that S. nigrum contains high levels of magnesium and phosphorus but relatively low level of zinc.

Akubugwo's study indicates the vitamin C content of s. nigrum to be of high value than vitamin A . Below are the other vitamins assessed from s. nigrum as follows:

- Vitamin A is 4.66±0.02 - 1.71±0 03
- Vitamin B1 is 17.14±0.01 10.91±0.01
- Vitamin C 35.18±0.02 23.38±0.01
- Folic acid 11.61±0.01 8.13±0.02
- Vitamin E 9.72±0.02 5.71±0.01 (Note; the values are mean ± S.D of triplicate determinations. On the other hand ,the phytochemical Compositions of Solanum nigrum L. Var. virginicum leaves and seeds are as follows :
- Mg- Composition (Mg- /100g) of Leaves /100g) of Seeds
- Alkaloids 1.62±0.02 1.07±0.05
- Saponins 0.25±0.01 0.16±0.01
- Falvonoids 0.81±0.01 1.01±0.01
- Anthocyanim 0.13±0.01 0.08±0.01
- Sterols 0.05±0.00 0.00±0.00
- Tannins 0.19±0.01 0.00±0.00
- Total Oxalate 78.65±0.04 58.81±0.01
- Phytic acid 0.82±0.01 04.48±0.02
- Total Polyphenol 13.17±0.02 14.69±0.01
- Cyanide 10.63±0.02 1.53±0.02 (Note; the values are mean±S.D of triplicate determinations. low.

However, from the study it shows that initial processing such as cooking is known to significantly reduce total oxalate content of vegetables . This may therefore mitigate the potent adverse effect of consuming the plant that Phytochemicals have potential beneficial effects such as polyphenols which reduce blood pressure while saponins may prevent cancer. It can therefor be concluded from the study that S. nigrum L. Var virginicum leaf and seed from Ebonyi state, Nigeria contain appreciable levels of protein,from the fibre and carbohydrate. S.Nigrum (am-amti) is a good source of magnesium, phosphorus and the water soluble vitamins such as vit C, B and folic acid. In summary therefore, the plant has high nutritional value and is recommended as a cheap source of plant protein, energy and mineral elements such as magnesium and phosphorus.

Colocasia sp. cf. formosana Hayata , another native or local or endemic to the province of Kalinga was analyzed and studied at Saint Mary's University, Bayombong, Nueva Vizcaya, Department of Chemistry shows the phytochemical screening, antimicrobial and cytotoxicity of the plant " pikaw" .

Pikaw has phythochemicals that include flavonoids, tannins, saponins, essential oil, triterpenes, fatty acids, sugar, coumarins, anthrones, phenols, alkaloids, steroids and anthraquinones.

In addition, pikaw ethanolic extract cannot inhibit bacteria S. aureus, E. coli and B. subtilis but it has high ability to inhibit the fungus C. albicans.

The range of the zones of inhibition of Pikaw ethanolic extract on Candida albicans from the study of Soliven show that the range is comparable with miconazole, cltrimazole and ketoconazole.

Hence, the Pikaw ethanolic extract can be made into products to serve as substitute of commercially available antifungal diseases caused by Candida albicans. Pikaw has also a cytotoxic property because after 18 hours the LC50 = 941.528 ppm, after 21 hours the LC 50 = 743.894 ppm and after 24 hours the LC50=634.807 ppm. From the study , it was recommended that pikaw can be processed as antifungal cream, ointment and other antifungal products since the ethanolic extract resemble the commercial preparations of miconazole, clotrimazole and ketoconazole.

M. Charantia (bitter melon or bitter gourd/ parya balang, paryat bakir) is a flowering vine in the family Cucurbitaceae. It is a tropical plant that is widely cultivated in Asia, India, East Africa, and South America for its intensely bitter fruits that are commonly used in cooking and as a natural remedy for treating diabetes.

It is a climbing perennial that usually grows up to 5 m, and bears elongated fruits with a knobbly surface. It is a

useful medicinal and vegetable plant for human health and one of the most promising plants for diabetes.

The main constituents of bitter melon which are responsible for the anti-diabetic effects are triterpene, proteid, steroid, alkaloid, inorganic, lipid, and phenolic compounds.

Several glycosides have been isolated from the M. charantia stem and fruit and are grouped under the genera of cucurbitane-type triterpenoids. In particular, four triterpenoids have AMP-activated protein kinase activity which is a plausible hypoglycaemic mechanism of M. charantia.

M. charantia fruits consist glycosides, saponins, alkaloids, reducing sugars, resins, phenolic constituents, fixed oil and free acids. M. charantia consists the following chemical constituents including alkaloids, charantin, charine, cryptoxanthin, cucurbitins, cucurbitacins, cucurbitanes, cycloartenols, diosgenin, elaeostearic acids, erythrodiol, galacturonic acids, gentisic acid, goyaglycosides, goyasaponins, guanylate cyclase inhibitors, gypsogenin, hydroxytryptamines, karounidiols, lanosterol, lauric acid, linoleic acid, linolenic acid, momorcharasides, momorcharins, momordenol, momordicilin, momordicin, momordicinin, momordicosides, momordin, momordolo, multiflorenol, myristic acid, nerolidol, oleanolic acid, oleic acid, oxalic acid, pentadecans, peptides, petroselinic acid, polypeptides, proteins, ribosome-inactivating proteins, rosmarinic acid, rubixanthin, spinasterol, steroidal glycosides, stigmasta-diols, stigmasterol, taraxerol, trehalose, trypsin inhibitors, uracil, vacine, v-insulin, verbascoside, vicine, zeatin, zeatin riboside, zeaxanthin, zeinoxanthin amino acids-aspartic acid, serine, glutamic acid, thscinne, alanine, g-amino butyric acid and pipecolic acid, ascorbigen, b-sitosterol-d-glucoside, citrulline, elasterol, flavochrome, lutein, lycopene, pipecolic acid. The fruit pulp has soluble pectin but no free pectic acid. Research has found that the leaves are nutritious sources of calcium, magnesium, potassium, phosphorus and iron; both the edible fruit and the leaves are great sources of the B vitamins.

Based on the multitude of medical conditions that bitter melon can treat, scientists are more and more interested in studying its bioactive compounds and their actions on the body. However, as many studies report, there has been substantial emphasis on the anti-diabetic compounds and their hypoglycemic properties.

A number of reported clinical studies have shown that bitter melon extract from the fruit, seeds, and leaves contain several bioactive compounds that have hypoglycemic activity in both diabetic animals and humans. Momordicine II and 3-hydroxycucurbita-5, 24-dien-19-al-7, 23- di-O-β-glucopyranoside (4), were isolated as saponins from M. charantia.

Both compounds showed significant insulin releasing activity in MIN6 β-cells at concentration of 10 and 25 µg/mL. The major compounds that have been isolated from bitter melon and identified as hypoglycemic agents include charantin, polypeptide-p and vicine.

Nutritional value

Nutritional value refers to the quantity and quality of nutrients found in the food item, according to the Healthy-food-site.com. Information about the energy (measured in calories), the macronutrients (carbohydrates, protein, fats), micronutrients (vitamins and minerals) and phytochemicals of the food are required to understand this

Total soluble solids

Total soluble solid is the amount of total soluble solid present in the unit volume of solution. It measures the sugar content of sugar solutions (honey, juices,syrup) which the sugar is the major component using refractometer is determined by the index of refraction. Total soluble solids is an important quality parameter in many food products. Its analysis is also a commonly practiced one. It typically indicates the amount of dissolved sugars in the product, thus affecting both safety and hedonic properties. It can be measured using a refractometer, which calculates the total soluble solids of the sample in °Brix. (Quality Parameters and Quality Control Methodologies | Coconut Handbook (tetrapak.com)

Total and reducing sugars

The most important sugars present in wine and fruit juice are the hexoses - glucose and fructose. These are the sugars that yeast ferment to produce alcohol. They have the characteristic of being reducing sugars, as they contain functional groups capable of being oxidised and therefore causing reduction of other species under specific conditions.

% Fat

Fats are important for good health and proper functioning of the body. They are a source of energy, essential fats and enhance the absorption of fat soluble vitamins. However, too much fat and/or the wrong type of fat may negatively affect our health.

Fats also give foods a particular texture, appearance and flavour. This article summarises the types of fats we eat, the foods in which they are found, their effect on our health, and the recommended consumption levels. Eating sufficient amounts of the right types of fats is important for a number of reasons. Dietary fats are a major source of energy for our bodies and are structural components of our body cells. The fat-soluble vitamins A, D, E and K cannot be absorbed by

the body without the help of fats. Some fats (e.g. omega-3 and omega-6) are essential as the body cannot produce them and therefore need to be obtained through diet. They are needed for vital processes such as brain, eye and heart function, growth and development. (EUFIC. (2015, September 22). Facts about fats. Eufic. Retrieved October 27, 2021, from https://www.eufic.org/en/whats-in-food/article/8-facts-on-fats)

Crude Protein

The term "crude protein" is really important to understand before one gets into the merits of its levels in poultry feed, or any feed for that matter. Normal, (wet chemistry) analysis of feed measures the nitrogen content of the feed and then, based on protein containing "on average" 16 % nitrogen, the value analysed is multiplied by 6.25 to arrive at a crude protein value. The assumption that all crude protein contains 16% nitrogen and that all the nitrogen found in feed, or feed ingredients, is actually protein really does result in a crude measure of the true protein in feed and hence the term used to describe it. However, crude protein still has its value as a quick and relatively cheap measure to assess whether theoretical feed formulation and actual feed analysis are comparable.

pH

The pH value of a food is a direct function of the free hydrogen ions present in that food. Acids present in foods release these hydrogen ions, which give acid foods their distinct sour flavor. Thus, pH may be defined as a measure of free acidity. More precisely, pH is defined as the negative log of the hydrogen ion concentration. Therefore, if a food has a pH value of 3.0, then the concentration of hydrogen ions present in that food is equal to 10-3 (0.001) moles/liter. And if the pH value is 6.0, then the concentration of hydrogen ions equals 10-6 (0.000001) moles/liter. These examples show that the concentration of hydrogen ions decreases as the pH value of the food increases. This explains the sometimes confusing fact that a low-pH food is a high-acid food and vice versa.

Ash

Ash refers to the inorganic residue remaining after either ignition or complete oxidation of organic matter in a foodstuff. A basic knowledge of the characteristics of various ashing procedures and types of equipment is essential to ensure reliable results. Two major types of ashing are used: dry ashing, primarily for proximate composition and for some types of specific mineral analyses; wet ashing (oxidation), as a preparation for the analysis of certain minerals. Microwave systems now are available for both dry and wet ashing, to speed the processes. Most dry samples (i.e., whole grain, cereals, dried vegetables) need no preparation, while fresh vegetables need to be dried prior to ashing. High-fat products such as meats may need to be dried and fat extracted before ashing. The ash content of foods can be expressed on either a wet weight (as is) or on a dry weight basis. This article would be primarily focusing on Estimation Of Ash Content In Food.

Ash content represents the total mineral content in foods. Determining the ash content may be important for several reasons. It is a part of proximate analysis for nutritional evaluation. Ashing is the first step in preparing a food sample for specific elemental analysis. Because certain foods are high in particular minerals, ash content becomes important. One can usually expect a constant elemental content from the ash of animal products, but that from plant sources is variable.

Dry ashing refers to the use of a muffle furnace capable of maintaining temperatures of 500–600◦C. Water and volatiles are vaporized, and organic substances are burned in the presence of oxygen in air to CO2 and oxides of N2. Most minerals are converted to oxides, sulfates, phosphates, chlorides, and silicates. Elements such as Fe, Se, Pb, and Hg may partially volatilize with this procedure, so other methods must be used if ashing is a preliminary step for specific elemental analysis.

Ash or mineral content is the portion of the food or any organic material that remains after it is burned at very high temperatures.

The ash constituents include potassium, sodium, calcium and magnesium, which are present in larger amounts as well as smaller quantities of aluminum, iron, copper, manganese or zinc, arsenic, iodine, fluorine and other elements present in traces.

Ash content represents the total mineral content in foods. Although minerals represent a small proportion of dry matter, often less than 7% of the total, they play an important role from a physicochemical, technological and nutritional point of view.

Determining the ash content may be important for several reasons. It is part of proximate analysis for nutritional evaluation. Ashing is the first step in preparing a food sample for determination of specific elemental analysis.

When powdered foods, are heated to a temperature of about 500°C for at least four hours, the water and other volatile constituents are evolved as vapors and the organic constituents are burnt off in the presence of oxygen of the air, to carbon dioxide and oxides of nitrogen and also eliminated together with hydrogen as water.

The ash content of most fresh foods rarely is greater than 5%. Pure oils and fats generally contain little or no ash;

products such as cured bacon may contain 6% ash and dried beef may be as high as 11.6% based on weight basis.

Ash content is a widely accepted index of refinement of foods, such as wheat flour or sugar. Since the mineral content of the bran is about 20 times that of the endosperm, the ash test is reliable indicator of the efficiency of which the separation of bran and germ from the rest of the wheat kernel.

III. RESEARCH PARADIGM

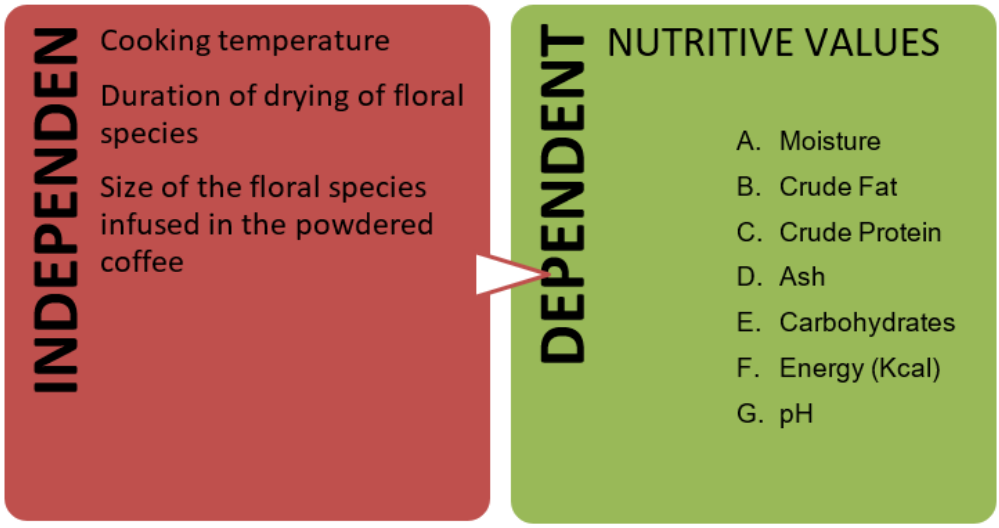

Fig.1. Research Paradigm

IV. OBJECTIVES

This study was conceptualized to identify the nutritive values of the three (3) floral species of Solanum nigrum var,*Colocasia* sp.cf.*Formosana hayata* , and *Momordica charantia* leaves with ground *Coffea canephora* or robusta, specifically, it aims to:

1. To identify the nutritive content of the enhanced coffee in terms of:

   A. Moisture
   B. Crude Fat
   C. Crude Protein
   D. Ash
   E. Carbohydrates
   F. Energy (Kcal)
   G. pH

V. MATERIALS AND METHODS

5.1 Locale of the Study

The study was conducted at Kalinga State University, Food and Analytical Laboratory, Bulanao Tabuk City, Kalinga. This is in cooperation with DOST-CAR for all procedures employed was adapted from the AOAC procedures. Sample preparation and determination of moisture, ash, pH, %Carbohydrates, and Calories was conducted at Kalinga State University, Food and Analytical Laboratory, Tabuk City, Kalinga. All analyses were conducted from January to December 2022.

5.2 Research Design

The study was experimental to determine the nutritive values. Results of the study was compared to the standard values as reflected Philippine Dietary Reference Intakes (PDRI) 2002 and Required Energy Intake (RENI) set by the Food and Nutrition Research Institute.

5.3 Data Gathering

The research proposal was submitted for the recommendation and approval of the Research Council. The researchers sought the supervision and recommendation of Ms. Jasmin Dona-al, a Registered Chemist who assisted one of the researchers, who is registered Chemical Technician for the experimental analyses.

5.4 Experimental Procedures

1. Drying phase of the raw materials

   A. Samples of of *Solanum nigrum* (SN) var locally termed as " am-amti",*Colocasia sp.cf.Formosana Hayata* (Col) aka " pikaw" , and *Momordica Charantia* (MC) wild aka " paryat bakir or parya balang" are cleaned thoroughly removing the stalks, petioles and hard or tough parts and set aside for aeration

of about a day on October 29, 2022 at Purok 2, Bulanao Norte, Tabuk City, Kalinga Province. A week long of sundrying was then employed.

B. When the desired texture was attained, the samples of Samples of SN, Col and CM were brought to the KSU-Analytical laboratory for pulverization and sieving.

Figure 1. Drying of floral species by Mr. Gringo Serion

Figure 2. Removal of foreign materials in the sample and sample preparation.

Figure 3. Roasting and preparation of Robusta coffee ready for sample preparation.

2. **Combination of *Coffea Canephora* powder with the pulverized 3 floral endemic species**

A. A one kilogram of green coffee beans was used as a baseline data which was set aside until all the necessary materials are prepared.

B. In a pre-heated wok at 150 ºC obtained, the green bean *Coffea canephora* were subjected for roasting for 30 minutes least .

C. The three flavor enhancers from dried endemic floral species were mixed to one kilogram of Coffea canephora. A mixture was made for evey floral specie included in the study. One (1) kilogram of coffee is enhanced with 250 grams of fine granules of the three dried endemic floral.

D. The mixture is subjected for heating at a temperature of 60 oC for another 15 minutes.

E. The mixture is brought to cooling temperature of 25 ºC

(average normal room temperature)

3. Nutritive Analysis

A. Moisture determination

Preparation of Cruscibles includes placing the the crucibles (with cover placed upside down) in the drying oven pre-heated to required temperature (following Appendix 1) for at least one hour. It was then transfered into a desiccator, cooled for 30 min and weighed (W1).

B. Samples were mixed thoroughly by turning the tightly closed bottle up and down three (3) times. Two (2) grams of samples were weighed in duplicate into a pre-weighed crucible (W2). Crucibles with sample inside are placed in the drying oven pre-heated to 100 ºC. The cover was placed upside down and was not fully covered the entire crucible to allow space for the release of heat/smoke/moisture.

Samples were heated for 4 hours starting when the oven reaches the desired constant temperature. At the end of the drying time, samples were transfered into a desiccator, cooled for 30 min and weighed (W3).

Calculations

$$\% \text{ Moisture} = \frac{W2 - (W3 - W1)}{W2} \times 100$$

where:

W1 = weight of empty crucible

W2 = weight of sample

W3 = weight of dish + sample after drying

C. % Fat

Preparation of Extraction Cups

The extraction cups was placed in the drying oven and dry at 100oC for at least 1hour then cool in a desiccator for 30 min. and weigh (W1).

Preparation of Test and QC sample

Sample was mixed by inverting the tightly closed bottle five (5) times. About 1 g of sample was weighed in duplicate into a filter paper (W2) and was placed on an aluminum dish. The sample was placed in the aluminum dish with filter paper in the drying oven at 100oC for 1hour. Dried sample was transferred and was wrapped with the filter paper into a thimble and proceed with the extraction procedure.

Extraction Procedure

The thimble with sample was inserted into the Soxtec system then 40 mL Petroleum ether was added to the extraction cups and was inserted them into the unit with extraction cups holder and proceed with the extraction. The extraction cups then be released and removed dried at 100oC for at least 1 hour. The cups was cooled at room temperature in a desiccator for 30 min. and was weighed (W3).

Calculations

Calculate the Crude Fat using the following formula:

$$\% \text{ Fat} = \frac{(W3 - W1) \times 100}{W2}$$

Where:

W1 = weight of extraction cup (empty)

W2 = weight of sample

W3 = weight of extraction cup + free fat

The result was expressed to the nearest hundredths (0.01%) in g per 100 g sample.

D. Crude Protein

The crude protein content was determined following the micro Kjeldahl method (AOAC 2005). Approximately 1 g of raw material was hydrolyzed with 15 mL concentrated sulfuric acid (H2SO4)containing two copper catalyst tablets in a heat block at 420 ◦C for 2 h. After cooling, H2O was added to the hydrolysates before

neutralization and titration. The amount of total nitrogen in the raw materials was multiplied with both the traditional conversion factor of 6.25 and species-specific conversion factors in order to determine total protein content. Percentage of nitrogen (N) was calculated using the following equation.

Nitrogen (%) = {(S-B) × N × 0.014 × D× 100} / (weight of sample × V)

Where:

D = Dilution factor

T = Titration value = (S-B)

W =weight of sample, 0.014 = Constant value.

Crude protein was obtained by multiplying the corresponding total nitrogen

content by a conventional factor of 6.25. Thus crude protein (%) = % of N × 6.25.

E. % Ash

The crucibles were placed (with cover placed upside down) in the hot air oven set at 100ºC at least one hour. The crucibles were transferred into a desiccator, and then cooled for 30 min and weighed and labeled as (W1). 2 grams of samples were weighed in duplicate into pre-weighed crucibles (W2) and analyzed using ashing conditions in Appendix A. Samples in crucibles were placed the furnace. The cover was placed upside down and not fully covered the entire crucible, allowing space for the release of heat/smoke/moisture.Samples were incinerated following ashing conditions in Appendix 1. The crucibles were placed in the hot air oven set at 100ºC at least one hour before transferring the crucibles in a desiccator, cooled for 30 min and weighed (W3).

Calculation:

g ash per 100g = (W3-W1)/W2 x100

Where: W1 = wt. of empty crucible, g
W2 = wt of sample, g
W3 = wt of crucible + ash, g

Reporting of ash in the test sample

Results were expressed to the nearest hundredths (0.01%) in g per 100 g sample

F. Computation of Carbohydrates

Total Carbohydrates= 100- (% Moisture+ %Ash +% Crude Protein + % Total Fat)* 1.03

G. Computation of Energy (Kcal)
Total energy in KiloCalories= ((4*% Protein)+(9*%Fat)+(4*Total Carbohydrates))*1.02

H. Procedures for pH Determination
To determine pH values, 5 g sample was blended with 20 mL of distilled water for 1 min using a homogenizer (Ultra-Turrax T25, Janke and Kunkel, Germany). The pH was then measured with a pH meter Benchtop Ph Meter (pH/MV AND EC/TDS/Salinity/Resistivity meter) Before measuring pH, the detector was calibrated with pH 4 and pH 7 buffer. All treatments were performed in triplicates.

Figure 4. Pulverization, grinding and mixing of floral species and coffee powder.

Figure 5. Physico-chemical analysis, determination of pH.

Figure 6. Weighing of crucibles as one of the procedures of proximate analysis.

Figure 7. Samples for Mositure and Ash Analysis including the positive control.

Figure 8. Cruscibles inside the furnace as one of the procedures indicated.

VI. RESULTS AND DISCUSSION

NUTRITIVE VALUES

Results of the laboratory tests revealed that in terms of nutritional value, enhanced coffee had a considerable amount of nutrients that could supplement the daily diet. Nutrients were available per 1 gram of sample. The table below summarizes the collected nutritive values.

Table 1. % Moisture of Enhanced coffee with floral species

Parameter	Enhanced coffee with floral species		
	SN	Col.	CM
Moisture, %	13.42	12.15	10.01

Results of the study showed that among the enhanced coffee, coffee enhance with Momordica charantia has the least moisture percentage among the three floral species.

Food makers pay close attention to the moisture (or total solids) content of their products for several reasons. Food quality, preservation, and resistance to degradation are all impacted by moisture. Calculating the moisture content is also required to determine the content of other food ingredients in a consistent manner (i.e., dry weight basis). Total solids are a term used to describe the dry stuff that is left behind following a moisture analysis.

Although moisture content is not listed on a nutrition label, it must be calculated to get the overall amount of carbohydrates.

Table 2. % Crude Fat content of Enhanced coffee with floral species

Parameter	Enhanced coffee with floral species		
	SN	Col.	CM
Crude Fat, % w/w	2.47	3.03	1.41

As gleaned on the table Colocossia var has the highest %crude fat among the three floral species which is inevitably low compared to another food source.

The overall amount of fat in a sample is measured as crude fat. Fats are crucial for the growth of the brain, the health of the skin, and the coat. T

Table 3. % Crude Protein content of Enhanced coffee with floral species

Parameter	Enhanced coffee with floral species		
	SN	Col.	CM
Crude Protein, % w/w	15.12	11.29	13.78

Protein is an important building block of bones, muscles, cartilage and skin. Experimental results showed that the enhanced coffee has considerable amount of protein where the sample with Solanum nigrum has the highest amount.

Table 4. % Ash content of Enhanced coffee with floral species

Parameter	Enhanced coffee with floral species		
	SN	Col.	CM
Ash, % w/w	6.35	6.68	6.46

While "mineral content" measures the quantity of particular inorganic components like Ca, Na, K, and Cl that are present in a food, "ash content" measures the total amount of minerals that are present in a food. The result of the study revealed that an average of 6.5% of ash content is present among the three floral species sample when compared with a normal bakery by-product was deemed higher that contains 2.5% only (https://www.feedtables.com/content/ash, 2022). Although about 99 percent of coffee is water, it helps to meet the body's nutritional needs. An 8-ounce cup of coffee delivers essential vitamins and minerals, including B1, B2, B3, and B5 vitamins, as well as Manganese, Potassium, Folate, and Phosphorous. (https://www.healthline.com/nutrition/coffee-good-or-bad#TOC_TITLE_HDR_2)

Table 5 % pH of Enhanced coffee with floral species

Parameter	Enhanced coffee with floral species		
	SN	Col.	CM
pH	5.6	5.8	6

Results have shown that the samples were mildy acidic. Coffee is weakly acidic and has a pH ranging from ~4.85 to ~5.10. Coffee contains over 30 organic and chlorogenic acids, and the acid content is different for different coffees. The acid content depends on various factors like roasting, grinding, and brewing conditions.

Table 6. Estimated Average Requirements per day of moisture, crude fat, crude protein, ash, carbohydrates, and energy (kcal)as per Philippine Dietary Reference Intakes 2015 of Enhanced coffee with floral species

Parameter	Enhanced coffee with floral species			Estimated Average Requirements per day*
	SN	Col.	CM	
Moisture, %	13.42	12.15	10.01	n/a
Crude Fat, % w/w	2.47	3.03	1.41	n/a
Crude Protein, % w/w	15.12	11.29	13.78	57-49**
Ash	6.35	6.68	6.46	n/a
Carbohydrates	64.52	68.86	70.39	55-79***
Energy (Kcal)	348	355	356	2530 (M) 1930 (F)

*Philippine Dietary Reference Intakes 2015

**Estimated Average Requirements per day of adults ages 19-70

***Acceptable Macronutrient Distribution Range for Adults≥19

The table above summarizes the collected nutritive values of Enhanced coffee with floral species and the Estimated Average Requirements per day of moisture, crude fat, crude protein, ash, carbohydrates, and energy (kcal)as per Philippine Dietary Reference Intakes 2015. It greatly implies that the Enhanced coffee with floral species can be a potential source of carbohydrates and minerals and showed an average of 2.3 % of crude fat. Data above showed that Enhanced coffee with floral species can supply 3% of the energy intake of an adult Filipino.

VII. SUMMARY AND CONCLUSION

The results of the laboratory tests showed that enhanced coffee with floral species had a significant number of nutrients that can supplement the daily diet in terms of nutritional value. Enhanced coffe with *Solanum nigrum* has % moisture of 13.42, Crude Fat, % of 2.47, Crude Protein % of 15.12, Ash content of 6.35% and a total of Carbohydrates 64.52% (w/w) with Energy of 348 Kcal per serving. On the other hand, enhanced coffee with *Colocasia sp.cf.Formosana hayata* has % moisture of 12.15 Crude Fat, % of 3.03, Crude Protein % of 11.29, Ash content of 6.68% and a total of Carbohydrates 68.86% (w/w) with Energy of 355 Kcal per serving. Results also showed that enhanced coffee with *Momordica charantia* has % moisture of 10.01 Crude Fat, % of 1.41, Crude Protein % of 13.78, Ash content of 6.46% and a total of Carbohydrates 70.39% (w/w) with Energy of 356 Kcal per serving.

To establish its nutrition facts, Enhanced coffee with floral species can supply 3% of the energy intake of an adult Filipino. Results showed that the natural product developed has low fat and can considerably supply minerals based from the % ash analysis. Samples can supply trace amount of protein as well. All enhanced coffee with floral species were mildly acidic based from its measyred pH.

VIII. IMPLICATIONS AND RECOMMENDATIONS

The present study explored the utilization of floral species locally grown in the Provice of Kalinga and traditionally used and can be seen in any palatable dish serve in an ykalingan table. Studies have shown that the demand for coffee is high but the supply is low thus innovation was formulated to aid in one way or another to meet the demand. Coffee imported into the Philippines appreciated in cost by 56.2% from $21.6 million during 2014. Year over year, imported coffee purchased by Filipinos spiked by 322.9% from $58.5 million in 2017. Result of the study suggested that enhancing the traditional coffee with floral species can be used alongside with its nutritive content enriched from the plants used.

The study further recommends to establish the microbiological quality of the samples for commercialization.

The acceptability, market analysis and utilization of other fruits and vegetables species that is locally grown and used traditionally in the province of Kalinga should be considered as well.

The researcher further recommends the quantification of amino acids and vitamins to be included in the diet and practice.

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APPENDIX A

SAMPLE	WEIGHT (g)	TEMP (ºC)	TIME*(h)	REFERENCE
Animal Feed	2	600	Until white ash	AOAC 942.05, Ch.4, p.8
Bread, Baked Products and Cereal Foods	3-5	550	Until light gray ash	AOAC 923.03 Ch.32, p.2
Fruit & Fruit Products	5-10	525	Until white ash	AOAC 940.26 Ch.37, p.7
Meat & Meat Products	3-5	550	Until gray/white ash	AOAC 920.153 Ch.39, p.4
All Other Food	2	550	Until white ash	AOAC 942.05