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Phytochemical constituents and proximate analysis of dry pineapple peels

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Abstract. The pineapple and its skin contain a lot of vitamin C, which helps to prevent and fight illnesses. Dry pineapple peel phytochemicals and proximate analysis were investigated in this study. Oil derived from ripe pineapple peels was tested for phytochemical constituents and proximate analysis of dry peel pineapple using a conventional method.Moisture content was 5.10±0.07%, the ash content was 3.78±0.05%, the fat content was 5.57±0.08%, the protein content was 5.78±0.10%, the crude fiber content was 4.10±0.06%, and the carbohydrate content was 75.68±0.86%. Alkaloid phenol, tannin, flavonoid, and saponin were identified as phytochemical components from the result of phytochemical screening.The presence of secondary metabolites in pineapple peel oil is a positive indicator that if thoroughly investigated, bioactive chemicals with significant biological activity may be extracted. As a result, it's plausible to believe that nutraceutical advantages can be derived from this waste (pineapple peel), potentially boosting humanity's prosperity, health and well-being.

Keywords: Oil extract, pineapples peel, proximate analysis, phytochemicals, nutraceutical..

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1. Introduction

Over the years,pineapple market has been growing extensively due to its attractive aroma compounds and nutritional values [1]. The crop can bear fruits at an early stage after flowering, allowing yield production throughout the year [2]. Consumption of pineapple, globally, is in large volume owing to its appreciable sensory featuressuch as acidity, sweetness, flavor, firmness etc[3]. In the twenty-first century, where the volume of trash created is a nuisance to man and his environment, the waste to wealth program should be a key component of sustainable living. Pineapple peel is an agro-waste of paramount value in such program. Not only can the pineapple peels aid digestion, but they have also been linked to the reduction of intestinal parasites, constipation, and Irritable Bowel Syndrome (IBS) symptoms. They also help to maintain a healthy gut flora. Recently, value added products were obtained from pineapple peel by green chemistry approach [4] and solid-state fermentation technique[5]. Pineapple waste was used for the production of bio-butanol through microbial degradation [6]. It's been recommended for decreasing swelling after surgery or injury, and it acts as an anti-inflammatory in the sinuses and throughout the body. The high quantities of vitamin C in the pineapple and its skin protect and fight infections, as well as perhaps IBS symptoms. They help build up healthy gut flora.Pineapple has been reported to have therapeutic potential such as antimicrobial [7], antimalarial [8],anti-inflammatory [9], antidiabetic [10], anti-oxidant [11], anticancer [12] activities among others.This means that pineapple could be a valuable source of important bioactive compounds that have countlessbeneficial for therapeutic application.

Pineapple is rich in bromelain, which is a potent enzyme anda cysteine protease [13]. It is found in high concentrations in the skin and stems of pineapples which aids in the reduction of inflammation in the body [14]. Bromelain and vitamin C function in the body as a bacteria fighter, mucus cutter, cough suppressor, wound healer, and overall system booster[15]. Bromelain also acts as an anti-inflammatory in people who suffer from arthritis[13]. Mixing a remedy with pineapple peels targets the cause of the discomfort directly. The entire plant contains beta carotene and vitamin C, which help to fight degenerative eye disorders like glaucoma. Pineapple skins also contain a lot of manganese, which helps to combat inflammation in the gums and tissues[16].Manganese aids in the development, strengthening, and repair of bones and teeth. Its vitamin C and astringent qualities maintain gums clean and healthy, which is good for dental health[17].Early research has indicated that the levels of manganese, vitamin C, bromelain, and antioxidants in the skin can help fight tumors and prevent cancer [17,18]. Bromelain prevents blood clots from forming[18], while pineapple juice's copper concentration promotes the production of healthy red blood cells. Potassium helps blood arteries stay healthy and can offset excessive levels of salt, allowing blood pressure to remain stable[19].Generally, women who are trying to conceive arerequired to watch their diet. Inflammation in the womb is reduced, which helps to produce a perfect environment for implantation. Warm liquids, such as the tea or broth, can also help with fertility, and a pineapple dessert wouldnot hurt.

2. Materials and Methods

All of the chemicals and reagents used were of analytical grade and provided by Covenant University's Department of Chemistry. The pineapples used in the study were obtained at Iyana-Iyesi, Ota, Ogun State, and were of excellent purity (>90%), so they could be utilized without additional purification.

2.1 Extraction and Isolation

As previously stated, the well-dried pineapple peels were crushed to powder and 70g of it was put into the thimble and set up on the Soxhlet extractor [20]. It was then extracted for 7 hours with n-hexane over a heated mantle. To recover n-hexane solvent and access percent of yellow oil, the mixture was concentrated with an IKA rotary evaporator at a decreased pressure. The technique was repeated on the powdered dried pineapples peel using methanolic hot extraction to obtain crude extracts for all other analyses outside the oil content analysis [21].

2.2 Proximate Analysis

The technique outlined in AOAC (2015) was used to successfully determine the closest parameters presented [22]. Each parameter was measured three times, with the mean and standard deviation of the error provided. The following equation was used to calculate the calorie value based on the numerical quantity of crude fat, protein, and carbohydrate:

$$Calorific\ Value = \left(\frac{Kcal}{100mg}\right) = (Protein\ x\ 4.00) + (Fat\ x\ 9.00) + (Carbonydrate\ x\ 3.75)$$

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2.3 Phytochemical Screening

In this work, the active principles were identified using a well-known technique and professionally confirmed methodology. For the purpose of simplicity, the presence of alkaloids was determined using Wagner's reagent; carbohydrates were determined using Molisch's test; cardiac glycosides were determined using Keller Kelliani's test; and flavonoids were detected using the alkaline reagent test; phenols are determined using the ferric chloride test; phlobatannins are determined using the precipitate test; proteins are determined using the ninhydrin test; saponins are determined using the foaming test; steroids are determined using the Liebermann-Burchard test; tannins are determined using the Braymer's test; terpenoids are determined using the Salkowki's test; quinones are determined using the HCl test; and oxa[20,23].

3. Results and Discussion

Overall, pineapple production in that year amounted to around 28.18 million metric tons out of which Costa Rica contributed 3.33 million metric[24].A considerable amount of agricultural waste was generated, particularly from the pineapple peel [25]. As a result, discarding pineapple peels after using the delicious juicy section contributed significantly to environmental pollution.Thus, as part of our waste-to-wealth program, we examined the proximate components of pineapple peel in order to verify its nutritious worth. This is in response to a revelation that pineapple peel may be used as molasses in animal feed [26].In order to discover secondary metabolites of therapeutic relevance in this agro-waste, phytochemical screening of extract of pineapple peels was performed. This will aid in the transformation of garbage into treasure; therefore, alleviating the environmental hazard posed by waste.

Table 1: Proximate determination from peels of pineapple

Items	Items Determined	%Composition[a]
1	Moisture content	5.10±0.07
2	Ash content	3.78±0.05
3	Crude Fat	5.57±0.08
4	Crude Fiber	4.10±0.06
5	Protein	5.78±0.10

6	Carbohydrate	75.67±0.86
7	Calorific value (Kcal/100g)	357.05±4.34

[a]mean ± standard deviation.

The extract of pineapple peel had 5.10±0.07% moisture, as determined by proximate analysis; the number is as expected owing to substantial moisture decrease due to the extended drying period it was subjected to (i.e., 12days). Increased moisture contributes significantly to the speed with which food spoils. The proximate determination showed that the protein content of pineapple peel was 5.78±0.10%;fat content was 5.57±0.08%; crude fiber was 4.10±0.06%. The carbohydrate content being determined through different by subtraction was 75.68±0.86%. Phytochemical screening also indicated the presence of carbohydrate which supported the proximate analysis result. As a result, total organic matter was 91.12%, whereas total dry matter was 8.88%. The protein value was calculated by multiplying the percent nitrogen by a conversion ratio of 6.25.With proximate analysis, the calorific value is usually necessary as well [27]. The calorific value was 357.05±4.34 based on the use of the equation in the material and technique. Because fiber is non-digestible and cannot be absorbed into the circulation, the fiber component is typically subtracted from carbohydrate before the calorific value is calculated [28].In the composition of livestock feed, pineapple peels might be a useful source of fat supply. When the fat level of pineapple peel in this study was compared to that of eleven cereals (Figure 1) in a prior study, this was clearly obvious [29,30]. As demonstrated in I the fat content of pineapple peel outperformed that of the eleven cereal meals.This means that the fat content of pineapple peels as agro-waste is higher than that of nutritious cereals like sorghum, wheat, and all types of millets in Figure 1. As a result, rather than allowing pineapple peels to continue to be a nuisance to man and his environment as a major pollution, pineapple peels can be recycled and used in livestock feed; its fat content can also enhance biofuel production.

Table 2: Phytochemical screening for metabolites identification in pineapple peel

Items	Phytochemicals	Availability
1	Alkaloids	+
2	Phenols	+
3	Tannin	+

4	Flavonoid	+
5	Saponin	+
6	Carbohydrate	+
7	Quinones	-
8	Glycosides	-
9	Steroids	-

Furthermore, pineapple peel includes alkaloids, phenol, tannin, flavonoid, saponin, and carbohydrate, according to Table 2. Alkaloids are naturally occurring nitrogenous bases with a long history of medicinal use as anti-protozoan parasites and anti-malarial[31].Koumine, an alkaloid, has recently been discovered to be an excellent defender against hydrogen peroxide-enhanced apoptosis epithelial cell line, IPEC-J2 cells [32]. The presence of phenol in this research matches that of a study that looked at phenol in three agricultural wastes (pineapple peels, pea peels, rice husk). As a result, the presence of alkaloids in pineapple peel might provide this extract therapeutic properties. The presence of carbohydrate in the pineapple peel indicated that it might be a useful source of energy for metabolic activities. Present of Flavonoids in pineapple peel help regulate cellular activity and fight off free radicals that cause oxidative stress on your body. In simpler terms, they help your body function more efficiently while protecting it against everyday toxins and stressors.Flavonoids are also powerful antioxidant agents. Antioxidants help your body fight off potentially harmful molecules that can be introduced to the body[33]. Pineapple peel was also shown to be a dependable source of tannin in the study.

4. Conclusion and Recommendation

Pineapple cultivation is quite time intensive and it grows best in tropical areas. Pineapple peels have been successfully analyzed in this study. It contains some phytochemicals which arealkaloids, phenols, tannin, flavonoid, saponin, carbohydrate. This is an indication that it may be used to make helpful medicines and could be used in the creation of valuable material with high economic value due to its nutraceutical properties.

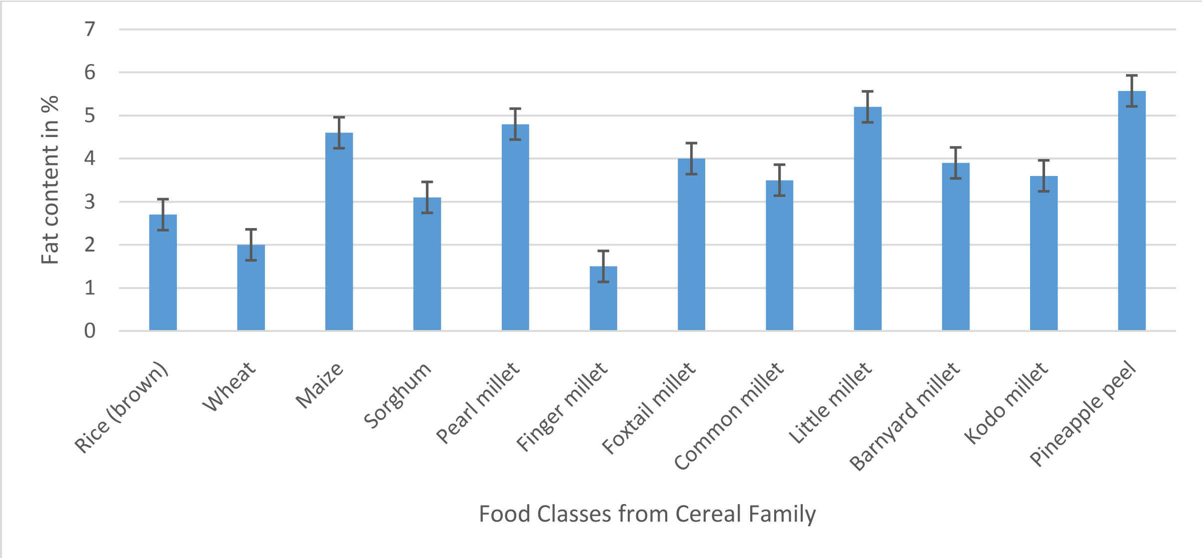

Figure 1: Comparative study of crude fat of pineapple peels with selected cereal.

It was also noted that protein content of pineapple peel was surprising higher than that of eleven cereals. This will aid in the transformation of garbage known as pineapple peels (agro-waste) into treasure; therefore, reducing the environmental impact of this waste.

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REFERENCES

[1] Abu Bakar, B.H., Ishak, A.J., Shamsuddin, R. and Wan Hassan, W.Z. (2013). Ripeness Level Classification for Pineapple using RGB and HSI Colour Maps. Journal of Theoretical and Applied Information Technology, 57(3): 587–593.

[2] Shamsudin, R., Zulkifli, N.A. and Kamarul Zaman, A.A. (2020). Quality Attributes of Fresh Pineapple-mango Juice Blend during Storage. International Food Research Journal, 27(1), 141–149.

[3] Nisha, A.P. and Radhamany, P.M. (2019). Cultivars and Local Varieties of *Ananas comosus* (L.) Merr. from Kerala. International Journal of Fruit Science 20(4): 1–15. https://doi.org/10.1080/15538362.2019.1628683.

[4] Campos D.A., Ribeiro T.B., Teixeira J.A., Pastrana L. and Pintado M.M. (2020). Integral Valorization of Pineapple (*Ananas comosus* L.) by-products through a Green Chemistry approach Towards Added Value Ingredients. Foods, 9: 60. https://doi.org/10.3390/foods9010060.

[5] Aruna T.E. (2019). Production of Value-added Product from Pineapple Peels using Solid State Fermentation. Innovation Food Science and Emerging. Technology, 57: 102193. https://doi.org/10.1016/j.ifset.2019.102193.

[6] Khedkar, M.A., Nimbalkar, P.R., Gaikwad, S.G., Chavan, P.V., Bankar, S.B. (2017). Sustainable Biobutanol Production from Pineapple Waste by using *Clostridium acetobutylicum* B 527: Drying Kinetics Study. Bioresources Technology, 225: 359–366.

[7] Thanish, A.S., Vishnu, P.V. and Gayathri, R.G.R.V (2016). Evaluation of Anti-microbial Activity of Pineapple Extract against Selected Oral Pathogen. Journal of Pharmaceutical Sciences and Research, 8(6): 491–492.

[8] Kumar, G., Deep, A., Kumar, S., Nandal, R., Singh, I., Kaushik, M., Hoti S.L., Rakesh K.M., Arun K.S. and Wadhwa, D. (2021). Phytochemical Screening, Antimalarial, Antioxidant, Anti-inflammatory, and Antimicrobial Potential of *Ananas comosus* extract.*Anti-Infective Agents*, 19(1): 49–56. https://doi.org/10.2174/2211352518999200429110222.

[9] Masbagusdanta, K., Setiasih, S., Handayani, S. and Hudiyono S. (2020).Partial Purification and Evaluation of Bromelain from Pineapple Stem (*Ananas comosus*) in Cream-based Preparation and its*In Vitro*Anti-inflammatory Activity. AIP Conference Proceedings 2243, 030012 (2020); https://doi.org/10.1063/5.0001345

[10] Kalpana, M.B., Prasath, G.S. and Subramanian, S. (2014). Studies on the Antidiabetic Activity of *Ananas comosus*Leaves in STZ Induced Diabetic Rats.Der Pharmacia Lettre, 6 (1): 190–198.

[11] Azizan, A., Lee, A.X., Abdul Hamid, N.A., Maulidiani, M., Mediani, A., Abdul Ghafar, S.Z., Zolkeflee, N.K.Z. and Abas, F. (2020). Potentially Bioactive Metabolites from Pineapple Waste Extracts and their Antioxidant and α-Glucosidase Inhibitory Activities by ^{1}H NMR. Foods, 9, 173; https://doi.org/10.3390/foods9020173/

[12] Ali, M.M., Hashim, N., Abd Aziz, S. and Lasekan. O. (2020). Pineapple (*Ananas comosus*): A Comprehensive Review of Nutritional Values, Volatile Compounds, Health Benefits, and Potential Food Products. Food Research International, 137: 109675. https://doi.org/10.1016/j.foodres.2020.109675

[13] Chakraborty, A.J., Mitra, S., Tallei, T.E., Tareq, A.M.,Nainu, F.,Cicia, D.,Dhama, K., Emran, T.B., Simal-Gandara, J. and Capasso, R. (2021). Bromelain a Potential Bioactive Compound: A Comprehensive Overview from a Pharmacological Perspective. Life, 11: 317.https://doi.org/10.3390/life11040317.

[14] Pavan, R., Shraddha, S.J. and Kumar, A. (2012). Properties and Therapeutic Application of Bromelain: A Review. Biotechnology Research International 2012: 976203. https://doi.org/10.1155/2012/976203.

[15] Joy, P.P. (2010). Benefits and Uses of Pineapple. Pineapple Research Station, Available at: http://www.kau.in/sites/default/files/documents/benefits_and_uses_of_pineapple.pdf

[16] Szalay, J. (2021). Pineapple: Nutrition Facts and Health Benefits. Retrieved on August, 18, 2021; Available online at: https://www.livescience.com/45487-pineapple-nutrition.html

[17] Dinyarian, K. (2020). How Vitamin "C" Can Help Gum and Teeth Health? Available online at: https://www.smileperfectors.com/blog/how-vitamin-c-can-help-gum-and-teeth-health/

[18] Nutrition and You (2021). Pineapple Nutrition Facts. Retrieved on August 16, 2021, Available at:https://www.nutrition-and-you.com/pineapple.html.

[19] Rudrappa, U. Nutrition and You (2021). Nuts Nutrition Facts. Available online at: https://www.nutrition-and-you.com/nuts_nutrition.html

[20] Ajani, O.O., Owoeye, F.T., Owolabi, F.E., Akinlabu, D.K. and Audu, O.Y. (2019). Phytochemical Screening and Nutraceutical Potential of Sandbox Tree (*Huracrepitans* L.) Seed Oil. Foods and Raw Materials, 7(1): 143–150.

[21] Owoeye, T.F., Ajani, O.O., Akinlabu, D.K. and Ayanda, O.I. (2017). Proximate Composition, Structural Characterization and Phytochemical Screening of the Seed Oil of *Adenanthera pavonine linn*. Rasayan Journal Chemistry, 10(3): 807–814.

[22] AOAC (2015). Official Methods of Analysis. Association of Official Analytical Chemists. 18th Edition, AOAC, Arlington, 806-814.

[23] Akinlabu D.K., Owoeye T.F., Owolabi F.E., Audu O.Y., Ajanaku, C.O., Falope F. and Ajani O.O. (2019). Phytochemical and Proximate Analysis of African Oil Bean (*Pentaclethra macrophylla* Benth) Seed.Journal of Physics: Conference Series, 2019, 1378(3), 032057.

[24] Shahbandeh, M. (2021). Leading Countries in Pineapple Production Worldwide in 2019. Available at: https://www.statista.com/statistics/298517/global-pineapple-production-by-leading-countries/

[25] Smeriglio, A., Cornara, L., Denaro, M., Barreca, D., Burlando, B., Xiao, J. and Trombetta, D. (2019). Antioxidant and Cytoprotective Activities of an Ancient Mediterranean Citrus (*Citrus lumia*Risso) Albedo Extract: Microscopic Observations and Polyphenol Characterization. Food Chemistry, 279: 347–355. https://doi.org/10.1016/j.foodchem.2018.11.138.

[26] Gavahian, M., Chu, Y.H. and Mousavi K.A. (2019). Recent Advances in Orange Oil Extraction: An Opportunity for the Valorisation of Orange Peel Waste A Review. International Journal of Food Science and Technology, 54(4), 925–932. https://doi.org/10.1111/ijfs.13987.

[27] Ozbayoglu, G. (2018). Energy Production from Coal, in: Comprehensive Energy Systems, 3, 788–821.

[28] Schwarcz, J. (2021). How is the Caloric Value of Food Determined? Nutrition, Office of Science and Society, McGill University Retrieved online on August 1, 2021; Available online at https://www.mcgill.ca/oss/article/nutrition/how-caloric-value-food-determined.

[29] Food and Agriculture Organization, FAO. (1995). Sorghum and Millets in Human Nutrition. Available online at: http://www.fao.org/3/t0818e/T0818E0b.htm#Continue

[30] Hulse. Laing and Pearson. 1980: United States National Research Council/National Academy of Sciences. 1982. USDA/HNIS. 1984.

[31] Tempone, A.G., Pieper, P., Borborema, S.E.T., Thevenard, F., Lago, J.A.G., Croft, S.L. and Anderson, E.A. (2021). Marine Alkaloids as Bioactive agents against Protozoal Neglected Tropical Diseases and Malaria. Natural Product Reports, https://doi.org/10.1039/D0NP00078G.

[32] Yuan, Z., Liang, Z., Yi, J., Chen, X., Li, R., Wu, Y., Wu, J. and Sun, Z. (2019).Protective Effect of koumine, an Alkaloid from *Gelsemium sempervirens*, on Injury Induced by H_2O_2 in IPEC-J2 Cells.International Journal of Molecular Sciences, 20(3): 754. https://doi.org/10.3390/ijms20030754.

[33] Piskounova, E., Agathocleous, M. and Murphy, M.M., et al. (2015). Oxidative Stress Inhibits Distant Metastasis by Human Melanoma Cells. Nature, 527(7577): 186–191.