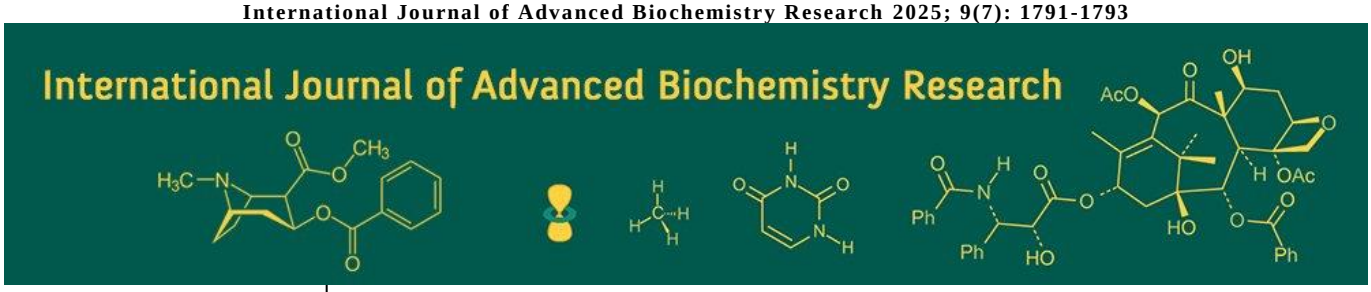


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# Compositional study of pineapple and ragi flour as a basis for pineapple pomace based cookies

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**Abstract**
The current investigation was undertaken to assess the physicochemical composition of pineapple (*Ananas comosus*) as a precursor for the production of functional cookies using ragi flour and pineapple pomace. In order to evaluate uniformity and potential for by-products, fresh pineapple fruits were examined for physical characteristics such as juice yield, pulp content, and pomace percentage over the course of two years. Furthermore, a thorough chemical evaluation was carried out, assessing the pineapple's moisture content and other pertinent components like pH, total, reducing and non-reducing sugars. Pineapple pomace, a fibrous by-product produced during juice extraction, has been recognized as a high source of dietary fiber and residual sugars, making it appropriate for value-added food applications. In addition, ragi flour was evaluated for critical chemical parameters such as moisture, ash, protein, fat and sugars to determine its functional contribution in cookie formation. The combination of pineapple pomace with nutrient-dense ragi flour aims to improve the nutritional value of cookies while encouraging waste reduction.

**Keywords:** Pineapple pomace, sustainable production, nutritional enhancement, cookie production, waste utilization

## Introduction
Pineapple is a delightful tropical fruit known for its abundant juiciness, tropical taste, and extensive health advantages. It boasts significant levels of calcium, potassium, vitamin C, carbohydrates, dietary fibre, water, and various minerals, which promote digestive health and aid in balanced nutrition (Hussain, 2015) [5]. Pineapple fruit includes an enzyme called bromelain, which aids in digestion and offers therapeutic benefits. Bromelain shows promise as an anti-inflammatory, antioxidant, anti-cancer, and heart-protective agent (Ali *et al.* 2020) [9]. Significant amounts of by-products are produced during processing, especially peel and pomace, which constitute approximately 30 and 35 percent of the fruit's weight (Sharma *et al.* 2020) [12]. A thorough understanding of the physico-chemical characteristics of pineapple pomace, such as its moisture content, ash content, pH, Sugars including (total, reducing, and non-reducing sugars), is essential for the efficient use of both fresh and dried forms of the pomace.

An ancient grain that is frequently consumed in South Asia and Africa is finger millet (*Eleusine coracana*), also referred to as ragi is well-known for its ability to withstand extreme weather conditions and for having a rich nutritional profile, particularly high levels of dietary fiber, calcium, iron, and polyphenols. (Devi *et al.* 2014) [3] The incorporation of ragi flour, which is made from finger millet, in functional nourishment has grown because of its gluten-free nature and health-promoting qualities. Ragi flour's successful inclusion into composite food products like cookies, biscuits, and extrudates is made possible by an understanding of its chemical composition, which includes components of protein, fat, ash, and carbohydrates.

The purpose of this study was to examine the physico-chemical constituents of pineapple and its pomace both fresh and dried as well as the chemical characteristics of ragi flour. The objective is to characterize the essential physical and chemical elements of these raw materials in order to establish a scientific basis for the production of nutrient-enriched, waste-utilizing food products.

## 2. Materials and Methods

### 2.1 Location of experiment site

In the academic year 2023-2024 and 2024-2025, a laboratory experiment was carried out at the Horticulture Processing Laboratory, Department of Fruit Science, College of Agriculture, Indira Gandhi Agricultural University, Raipur (C.G.).

### 2.2 Materials

Fresh, ripe pineapple fruits of uniform maturity were purchased from a local market in (Raipur). Ragi grains (Finger millet) were obtained from a store and their physical and chemical composition was evaluated further before the preparation of cookies.

### 2.3 Physical characteristics of Pineapple

Standard protocols were used to manually quantify the physical features of pineapples (FAO, 2003) [4]. The fruit's components were separated through washing, peeling, and processing. Using a digital balance, the following parameters were measured and reported in grams or weight percentage. Fruit weight (g), Peel Weight (g), Pulp weight (g), Juice Content (% w/w) and pomace (%). All were recorded in both the years.

### 2.4 Preparation of Pineapple Pomace

Using a mechanical juicer, the juice was extracted. As fresh pomace, the leftover fibrous residue was collected. One portion was tested right away, and the rest was dried to constant weight in a hot-air oven set at 60±2 °C (AOAC, 2016) [1]. For additional analysis, the dried pomace was ground in a lab grinder and kept in airtight containers**.**

### 2.5PineapplePomace:APhysico-ChemicalStudy

Both fresh and dried pineapple pomace were found to have the following characteristics.Using the oven drying method at 105 °C, the moisture content (%) was determined (AOAC, 2016) [1]. Ash (%) was determined using a process that involved incineration at 550 °C in a muffle furnace, and a weighing equipment was used to determine the final weight (AOAC, 2016) [1]. A digital pH meter and a 1:10 w/v aqueous extract were used to determine the pH (Ranganna, 2000) [10]. The Lane and Eynon titration method (Ranganna, 2000) [10] was used to determine the total sugars (%). likewise reducing sugar (%) was determined and non-reducing sugar (%) was calculated by the differerence between the total and reducing sugar.

### 2.6 Chemical Composition of Ragi Flour

The flour was kept at room temperature in sealed containers until it was analyzed. Proximate composition of ragi flour was determined using the following methods where Moisture content (%) was calculated through Hot air oven method at 105 °C (AOAC, 2016) [1], Ash content (%) was recorded by muffle furnace at 550 °C (AOAC, 2016) [1], Protein (%) through Kjeldahl method with nitrogen conversion factor 6.25 (AOAC, 2016) [1], Fat (%) was evaluated by Soxhlet extraction method using petroleum ether (AOAC, 2016) [1] and Total, reducing and non-reducing sugars (%) through Lane and Eynon method (Ranganna, 2000) [10].

## 3. Results and Discussion

After experiment, the findings revealed the results and those have been presented here in the following:

### 3.1Physical composition of pineapple fruit

Table 1 lists the physical characteristics of pineapple fruit that were measured in 2023-2024 and 2024-2025. Fruit weighed 0.980 kg in 2023-2024 and 1.130 kg in 2024-2025 Similar readings were observed by Bhore *et al.* (2017) [2] in "Giant Kew" pineapple variety. Pulp weighed 719.02 g in the 1st year and 765.3 g in the 2nd year. The peel weighed 261.42 g in first year and 365.05 in the second year. The pomace yield was 210.72 g and 227.65 g in both the years respectively. The juice content recorded was 54.5% in the year 2023-24 and 60.3% in year 2024-25. The data recorded for Fruit pulp (g), Juice content (%) and Pomace (g) were in close agreement with MDPI review (2022).

**Table 1:** Physical composition of pineapple fruit

| Fruit characters | 2023-24 | 2024-25 |
|---|---|---|
| Fruit Weight (kg) | 0.980 | 1.130 |
| Fruit pulp (g) | 719.02 | 765.3 |
| Fruit peel (g) | 261.42 | 365.05 |
| Juice content (%) | 54.5 | 60.3 |
| Pomace (g) | 210.72 | 227.65 |

### 3.2 Chemical Composition of Pineapple Pomace

The physico-chemical parameters of fresh and dry pineapple pomace were investigated for two years in a row (Table 2). In 2023, fresh pomace recorded 65.56% moisture, 3.46% ash and a pH of 4.01. Total sugar, reducing sugar and non-reducing sugar percentages were 12.46%, 8.14% and 4.32%, respectively. In 2024, fresh pomace recorded 56.54% moisture, 3.21% ash, a pH of 3.86 and total, reducing, and non-reducing sugars of 12.20%, 8.21% and 3.99%, respectively.

In the case of dried pomace, 2023 samples had 20.56% moisture, 3.89% ash, pH 4.01 and sugars of 10.20%, 6.21% and 3.99%. In 2024, dried pomace contained 15.23% moisture, 3.54% ash and pH 3.86, with total, reducing, and non-reducing sugars of 10.16%, 6.26% and 3.90%, respectively. similar moisture percent was recorded by Hossain *et.al*. The ash (%) in fresh pomace and also the pH of the fruit recorded in both the years were closely related with the findings of Upadhyay *et al.* The data observed in sugars including total sugar, Reducing and Non-reducing sugar % were similar with the findings of Hemalatha *et al.* (2013) [6].

**Table 2:** Chemical composition of pineapple fruit

| Pineapple Pomace | Moisture% | | Ash% | | pH | | Total Sugar% | | Reducing Sugar% | | Non-Reducing Sugar% | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2023 | 2024 | 2023 | 2024 | 2023 | 2024 | 2023 | 2024 | 2023 | 2024 | 2023 | 2024 |
| Fresh Pomace | 65.56 | 56.54 | 3.46 | 3.21 | 4.01 | 3.86 | 12.46 | 12.20 | 8.14 | 8.21 | 4.32 | 3.99 |
| Dry Pomace | 20.56 | 15.23 | 3.89 | 3.54 | 4.01 | 3.86 | 10.20 | 10.16 | 6.21 | 6.26 | 3.99 | 3.90 |

### 3.3 Chemical Composition of Ragi Flour

In 2023 and 2024, ragi flour's proximate composition was examined (Table 3). 12.01% moisture, 2.0% ash, 7.5% protein, and 1.3% fat were present in the ragi flour in 2023. 4.09% total sugar, 1.41% reducing sugar and 2.68% non-reducing sugar were observed in the sugar content.

In the year 2024 it was noted that 11.86% moisture, 2.2% ash, 6.98% protein, 1.5% fat, 3.90% total sugar, 1.52% reducing sugar, and 2.38% non-reducing sugar in ragi flour. The results validate that ragi flour is a gluten-free, nutritionally dense grain that can be used in bakery and health-based product formulations. In chemical composition of Ragi flour the data recorded under moisture percent, ash %, protein % and fat % were closely similar with the findings of Shanmugam *et al.* (2013) [11]. Altough very low percent of sugars were observed in ragi flour.

**Table 3. Chemical Composition of Ragi Flour**

| Ragi flour | Moisture% | | Ash% | | Protein% | | Fat% | |
|---|---|---|---|---|---|---|---|---|
| | 2023 | 2024 | 2023 | 2024 | 2023 | 2024 | 2023 | 2024 |
| | 12.01 | 11.86 | 2.0 | 2.2 | 7.5 | 6.98 | 1.3 | 1.5 |

| Ragi flour | Total Sugar% | | Reducing sugar% | | Non-Reducing sugar% | |
|---|---|---|---|---|---|---|
| | 2023 | 2024 | 2023 | 2024 | 2023 | 2024 |
| | 4.09 | 3.90 | 1.41 | 1.52 | 2.68 | 2.38 |

### Conclusion

The study found that pineapple has a high pulp and juice content, as well as excellent physicochemical properties, making it appropriate for processing and pomace recovery. Ragi flour had a high nutritional content, particularly in dietary fiber and protein. The combined examination of both ingredients demonstrates their potential as complementing raw materials for making nutritionally rich cookies. This provides a solid foundation for potential product development, promoting the sustainable use of pineapple by-products and functional food development**.**

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