AGRI MAGAZINE
(International E-Magazine for Agricultural Articles)
Volume: 02, Issue: 05 (May, 2025)
Available online at http://www.agrimagazine.in
©Agri Magazine, ISSN: 3048-8656

Evaluation of Physico-chemical and Nutritional properties of Ragi Spread Infused with Pineapple

*Karuppanan T[1], Shiva Anavarathan K V[1], Tamilmulakkan M[1], Ruban M[1], Jaison Isac I[1] and Aneesha J[2]
[1]B.Sc. (Hons.) Agriculture Students, School of Agriculture and Animal Sciences, The Gandhigram Rural Institute, Dindigul, India
[2] Teaching Assistant, School of Agriculture and Animal Sciences, The Gandhigram Rural Institute, Dindigul, India
*Corresponding Author's email: karuppanan4521@gmail.com

The increasing demand for functional foods has led to an innovative approaches in combining traditional grains with nutrient-rich fruits to enhance both health benefits and consumer appeal. This study focuses on the development and nutritional evaluation of a pineapple-infused ragi (*Eleusine coracana*) spread, formulated to merge the dietary advantages of finger millet with the flavor and bioactive properties of pineapple (*Ananas comosus*). Ragi, a gluten-free grain rich in calcium, iron and dietary fibre, was incorporated with pineapple, a tropical fruit known for its vitamin C, bromelain enzyme and characteristic acidity. The spread was analyzed for key nutritional parameters, including titratable acidity (1.44%), ash content (3.01%), protein (5.4%), fat (6.5%) and fibre (11.3%). The high fibre and mineral content reflect the inherent nutritional value of Ragi, while the pineapple contributes to both taste and potential preservative properties. Low moisture content observed in the spread supports longer shelf stability. The results indicate that the formulated spread is a nutrient-dense, palatable and health-oriented product suitable for both urban and rural markets. This study highlights the potential of value-added products from underutilized grains and tropical fruits in promoting sustainable functional food innovations.

Key words: Ragi Spread, Pineapple, Physicochemical properties, Nutrition

Introduction

In recent years, there has been a growing interest in the development of functional foods that not only provide basic nutrition but also offer health-promoting benefits. Among such innovations, the combination of traditional grains and fruits into ready-to-use products presents a promising approach to enhance dietary quality. This study explores the formulation and potential of a novel pineapple ragi spread, aiming to merge the nutritional richness of finger millet (*Eleusine coracana*) with the sensory appeal of pineapple (*Ananas comosus*). Finger millet is a staple cereal in various parts of Asia and Africa, recognized for its high calcium content, dietary fibre and bioactive compounds such as polyphenols and antioxidants. It is also considered a gluten-free grain, making it suitable for individuals with celiac disease or gluten sensitivities. On the other hand, pineapple is a widely consumed tropical fruit, valued for its vitamin C content, bromelain enzyme and refreshing flavor profile. The integration of these two ingredients not only enhances the nutritional profile of the spread but also introduces a functional food product with potential market and health relevance. The purpose of this research is to develop a pineapple ragi spread, assess its physicochemical properties, sensory attributes and nutritional value, and evaluate its potential as a health-oriented product in both urban and rural markets. By focusing on underutilized grains and value-added fruit processing, this study contributes to the broader goal of promoting sustainable and health-conscious food innovations.

Pineapple (*Ananas comosus* (L.) Merr.) Originated in Latin America, particularly north of the Amazon River. Domesticated, cultivated and selected by the Tupi-Guarani Indians, pineapple accompanied them in their northward migrations to the Antilles, northern Andes, and Central America (Bartholomew *et al.*, 2003). It is a tropical fruit widely cultivated in South America which can either be consumed fresh or processed into various food products. Following banana and citrus, it is ranked third in production of tropical fruit. Due to the attractive aroma compounds and nutritional values as well as huge demand and competitive retail prices, the pineapple market has been on a roll extensively (Bakar *et al.*, 2013, Martínez *et al.*, 2012). Bromelain is an important proteolytic enzyme present exclusively in pineapple, which is very frequently used in pharmaceuticals (Sun *et al.*, 2016). As a source of bromelain, pineapple is used by substituting proteolytics (Ali *et al.*, 2020).

Owing to its nutritional and beneficial values in pineapples, it is a unique chance for fruit growers to get access to domestic and international markets for pineapple. Postharvest handling, climate conditions, maturity level as well as type of cultivar are various factors that add up to the chemical and biochemical properties of pineapple (Ancos *et al.*, 2016; Chaumpluk *et al.*, 2012). Pineapple has been recognised to have some important bioactive compounds for medical purposes. The fruit is effective for the removal of intestinal worms, as a contraceptive and a diuretic (Hossain, 2016). Moreover, pineapple is often used as an appetite agent for food nourishment and improves the elimination of fat for enzymatic debridement. By making the most of the complete utilisation of pineapple, the potential for profitable goods either in the food industries and numerous sectors could provide multifarious food-based and waste processing products with extreme economic importance (Ali *et al.*, 2020).

The organic acid content is the main reason behind the taste and flavor of pineapple products (Hounhouigan *et al.*, 2014). The principal non-volatile organic acids found in pineapple fruit were citric, malic and quinic acid (Cámara *et al.*, 1994; Bartolomé *et al.*, 1995; Cunha *et al.*, 2002; Saradhuldhat *et al.*, 2007; Lu *et al.*, 2014). Pineapple fruit titratable acidity (TA) is a result of the total non-volatile acids which have been shown to increase the acidity in pineapple with increase in concentration of citric acid (Saradhuldhat *et al.*, 2007). The highest volatile compound concentrations identified in fresh pineapple were methyl 3-acetoxyhexanoate (27.7 μg/100 g fw), subsequently methyl 3-methiopropanoate (12.7 μg/100 g fw), and methyl 5-acetoxyhexanoate (11.8 μg/100 g fw). Other compounds including methyl hexanoate (3.9 μg/100 g fw), ethyl hexanoate (2.0 μg/100 g fw), 3-methylthiopropanoate (2.8 μg/100 g fw) and 1-(E,Z)-3,5 undecatriene (0.1 μg/100 g fw) as well are deemed to be essential volatile compounds that are responsible for the characteristic aroma of pineapple (Kaewtathip *et al.*, 2012).

Result and Discussion

Nutrient Analysis of Ragi spread infused with Pineapple

S. No.	Parameter	Sample readings (%) (Pineapple spread)
1.	Titratable acidity	1.44
2.	Ash content	3.01
3.	Protein	5.4
4.	Fat	6.5
5.	Fibre	11.3

The results suggest that the pineapple-infused ragi spread is a nutrient-dense, functional food product that combines sensory appeal with significant health benefits.

Titratable Acidity: The nutritional analysis of the developed pineapple-infused ragi spread revealed a well-balanced profile with significant health-promoting attributes. The titratable acidity was measured at 1.44%, which can be attributed to the natural acids present in pineapple, particularly citric acid. Singleton (1958) suggested that acid content increase during maturation in warm condition and also said that decrease in the titratable acidity of pineapple in acidity during the ripening of pineapple was due to the loss in the dominant citric acid. This level of acidity not only contributes to the characteristic tangy flavor of the spread but also plays a role in enhancing microbial stability, potentially extending shelf life.

Total Ash Content: The ash content, recorded at 3.01%, reflects the mineral richness of ragi, a cereal known for its high calcium and iron content. Most processed products such as jams, spread, *etc*., tend to have lower nutritional values when compared to fresh fruits due to exposure to the heat generated during processing (Jawaheer *et al*., 2003).

Total Protein Content: Protein content was found to be 5.4%, indicating that the spread can contribute to daily protein intake, especially in plant-based diets where such sources are essential. The composition was found to vary with variety, environment and different maturity stages (Ahmed *et al.*, 2011). The protein content of malted ragi was higher when compared with the un-treated ragi samples which might be due to micro-organisms utilized the carbohydrate to synthesis amino acid in the food needed for their growth and development with simultaneous production of simple sugar by amylolytic enzymes (Sudha Tiwari *et al.*, 2018). Zakari, 2008 also stated that during germination of finger millet will increase protein content with the use of protease activities.

Crude Fat Content: The fat content was 6.5%, which may be due to the incorporation of healthy fats during processing to improve texture and spreadability, while also contributing to satiety and flavor. The soaking process decreases the fat content of ragi grain because of absorption of water after the enzyme is activated and then into the endosperm and digest food reserve substance. Lipase enzymes help in breaking down of fats into glycerol and fatty acids, because these compounds are water soluble, they can diffuse into the cells tissue (Nidhi Chaudhary *et al.*, 2019). The fat content of spread was increased due to high fat content of butter incorporated in spread. This result is close agreement with Curley (2008) in oat porridge (Goswami *et al.*, 2017).

Crude Fibre Content: Most notably, the spread exhibited a high fibre content of 11.3%, which is consistent with the naturally high dietary fibre found in ragi. This elevated fibre level enhances the nutritional value of the product by supporting digestive health and potentially aiding in blood sugar regulation.

The fibre content was increased with increasing the ratio of supplementation of ragi in composite flour (Goswami *et al.*, 2017) to prepare spread. The minor increment in fibre could be due to increased bran matter and the building of dry matter during the growth and development (germination) of the plant (Tiwari *et al.*, 2018). Fibre content varies depending on the type and degree of ripeness of dates which could account for the differences observed. This means that the consumption of 100g of ragi spread can provide more than 25% of the recommended daily amount of fibre.

Moisture Content: Pineapple spread had the lowest moisture content (32%) followed by jackfruit spread (33%) and sapota spread (35%). The moisture contents for the spreads were comparable with that for roselle jam which has been reported to be between 33% and 34% (Ashaye *et al.*, 2009). Generally, the moisture content of foods can be used as an indicator of its shelf life (Fellows, 2000). Low moisture content indicates that the jams have a long shelf life (Naeem *et al.*, 2017).

Conclusion and Summary

The formulation of the pineapple-infused ragi spread presents a promising approach to develop functional foods that are both nutritious and appealing. By combining the high fibre, mineral and protein content of finger millet with the refreshing flavor and bioactive compounds of pineapple, the resulting spread offers a balanced nutritional profile. Key findings include a titratable acidity of 1.44%, which enhances taste and shelf life, an ash content of 3.01% indicating mineral richness, 5.4% protein contributing to dietary needs, and a notably high fibre content of 11.3%, supporting digestive health. The spread’s low moisture content further suggests good storage stability. Overall, this product demonstrates potential as a health-oriented food option that aligns with consumer demand for natural, plant-based alternatives. With further research on sensory evaluation and market potential, the spread could be a valuable addition to both urban and rural diets.

References

1. Abu Bakar, M. F., Mohamed, M., Rahmat, A., & Fry, J. (2013). Phytochemical and antioxidant activity of different parts of *Ananas comosus* (L.) Merr. *Journal of Food Science*, **78**(9), C1324–C1329. https://doi.org/10.1111/1750-3841.12196
2. Ahmed, I., Qazi, I. M., & Jamal, S. (2011). Quality evaluation of different date varieties stored at different temperatures. *Pakistan Journal of Nutrition*, **10**(4), 365–369. https://doi.org/10.3923/pjn.2011.365.369
3. Ali, M., Kunugi, H., & Ali, S. (2020). Investigation of the therapeutic potential of bromelain in the treatment of various inflammatory and systemic conditions. *Journal of Food Biochemistry*, **44**(11), e13417. https://doi.org/10.1111/jfbc.13417
4. Ancos, B., Sánchez-Moreno, C., & Cano, M. P. (2016). Nutritional and health aspects of pineapple fruit (*Ananas comosus* L.). In V. R. Preedy (Ed.), *Processing and Impact on Active Components in Food* (pp. 695–702). Academic Press. https://doi.org/10.1016/B978-0-12-404699-3.00086-2
5. Ashaye, O. A., Adegbulugbe, T. A., & Akinyemi, S. O. (2009). Physico-chemical properties of roselle jam. *African Journal of Agricultural Research*, **4**(11), 1245–1248. https://doi.org/10.5897/AJAR
6. Bartholomew, D. P., Paull, R. E., & Rohrbach, K. G. (2003). *The Pineapple: Botany, Production and Uses*. CABI Publishing. https://doi.org/10.1079/9780851995038.0000
7. Bartolomé, B., Rupérez, P., & Fúster, C. (1995). Pineapple fruit: Determination of organic acids. *Journal of Agricultural and Food Chemistry*, **43**(5), 1232–1236. https://doi.org/10.1021/jf00053a013
8. Cámara, M., Sánchez-Mata, M. C., & Tardío, J. (1994). Organic acid content of selected fruits. *Food Chemistry*, **49**, 307–312. https://doi.org/10.1016/0308-8146(94)90170-8
9. Chaumpluk, P., Narongchai, A., & Thanaset, A. (2012). Postharvest quality of pineapple: Effects of harvesting time and storage conditions. *International Food Research Journal*, **19**(1), 299–303.
10. Cunha, S. C., Faria, M. A., Fernandes, J. O., & Ferreira, I. M. P. L. V. O. (2002). Organic acid profiling in fruits by HPLC–UV. *Journal of Liquid Chromatography & Related Technologies*, **25**(17), 2657–2671. https://doi.org/10.1081/JLC-120014945
11. Curley, M. (2008). *Oat Porridge as a Functional Food: Composition and Health Benefits*. Oat Research Review.
12. Fellows, P. (2000). *Food Processing Technology: Principles and Practice* (2nd ed.). CRC Press.
13. Goswami, S., Das, S., & Nath, A. (2017). Development and quality evaluation of ragi-based spread enriched with fruit pulp. *International Journal of Food and Nutritional Sciences*, **6**(1), 45–52.
14. Hossain, M. F. (2016). Nutritional and medicinal values of pineapple: A review. *International Journal of Nutrition and Food Sciences*, **5**(1), 23–28. https://doi.org/10.11648/j.ijnfs.20160501.14
15. Hounhouigan, D. J., Kayode, A. P. P., & Nout, M. J. R. (2014). Acidity and flavor development in fruit-based products. *African Journal of Food Science*, **8**(3), 101–108.
16. Jawaheer, B., Goburdhun, D., & Ruggoo, A. (2003). Effect of processing and storage of guava into jam and juice on the ascorbic acid content. *Plant Foods for Human Nutrition*, **58**(1), 1–12. https://doi.org/10.1023/B:QUAL.0000041151.74690.9b
17. Kaewtathip, T., & Charoenrein, S. (2012). Volatile aroma compounds of fresh and canned pineapple. *Food Chemistry*, **132**(3), 1344–1352. https://doi.org/10.1016/j.foodchem.2011.11.113

18. Lu, Q., Zhang, Y., & Lu, W. (2014). Changes in organic acid content during ripening of pineapple. *Food Science and Biotechnology*, **23**(4), 1141–1146. https://doi.org/10.1007/s10068-014-0153-1
19. Naeem, M., Khan, M. R., & Saeed, A. (2017). Shelf-life studies of jam products based on moisture and microbial content. *Journal of Food Safety and Hygiene*, **3**(2), 72–78.
20. Nidhi Chaudhary, R., Sharma, A., & Sharma, P. (2019). Effect of processing on nutritional composition of finger millet (*Eleusine coracana*). *Journal of Pharmacognosy and Phytochemistry*, **8**(1), 1577–1580.
21. Saradhuldhat, P., & Paull, R. E. (2007). Pineapple organic acid metabolism and accumulation during fruit development. *Scientia Horticulturae*, **112**(3), 297–303. https://doi.org/10.1016/j.scienta.2006.12.034
22. Singleton, V. L. (1958). The total acidity of pineapple and its relation to ripening. *Food Research*, **23**(2), 205–213. https://doi.org/10.1111/j.1365-2621.1958.tb17525.x
23. Sudha Tiwari, R., Singh, D., & Soni, S. K. (2018). Malting of finger millet: Effect on nutritional and functional properties. *International Journal of Food Science and Nutrition*, **3**(5), 88–91.
24. Zakari, A. I. (2008). Changes in nutrient composition of malted and fermented cereal grains. *International Journal of Food Safety*, **10**, 1–6