ISSN NO: 0130-7673

Development and Nutritional Characterization of Fortified Mango Fruit Leather: A Comparative Study of Pulp and Leather

Shaikh Mohammad Sohel[1], B.M.Patil[2], Syed Zubair[3], B.S.Agarkar[4], Ansari Mohammed Ahmed Rayyan[5]

1. M.Tech, Department of Food Engineering, College of Food Technology, VNMKV PARBHANI.

2. Assistant Professor, Department of Food Engineering, College of Food Technology, VNMKV PARBHANI.

3. Assistant Professor, Department of Food Engineering, College of Food Technology, VNMKV PARBHANI.

4. Associate Professor, Department of Food Engineering, College of Food Technology, VNMKV PARBHANI.

5. M.Tech, Department of Food Microbiology and Safety, College of Food Technology, VNMKV PARBHANI.

Abstract

Fruit leathers are nutrient-rich, shelf-stable snacks derived from dehydrated fruit purees, offering a convenient alternative to fresh fruits while aiding in the reduction of post-harvest losses. This study aimed to develop mango fruit leather fortified with whey protein concentrate and evaluate its nutritional enhancement through a comparative analysis of raw mango pulp and the resulting leather. Mango pulp was blended with sugar, pectin, and 12% whey protein, then dried in a cabinet dryer at 60 °C for 7 hours. The optimized process yielded a leather with desirable moisture content (19.13%) and acceptable sensory attributes. Proximate and mineral analyses revealed that the leather had significantly higher crude protein (15.89%), carbohydrates (58.26%), dietary fiber (14.06%), and essential minerals such as calcium, potassium, and magnesium compared to the fresh pulp. These improvements are attributed to both the fortification and concentration effects during dehydration. The study highlights the potential of fortified fruit leather as a functional food product that can contribute to addressing nutritional deficiencies and promoting dietary diversity.

1. Introduction

Fruit leathers are dehydrated fruit-based products made from fruit purees and formulated to yield flexible, chewy, and shelf-stable snacks. They are commonly prepared using a variety of fruits, such as mango, apple, guava, and other tropical or temperate species. The final composition of the leather depends largely on the specific fruit used, particularly due to inherent variations in pectin, sugar, and organic acid content (Diamante et al., 2014). To enhance textural and sensory properties, fruit purees are often fortified with hydrocolloids, sugars, or preservatives, contributing to improved color retention, shelf life, and nutritional density.

Initially developed as a small-scale preservation method, fruit leathers have gained prominence as functional snacks owing to their favorable nutritional profiles—being low in fat, calorie-dense, high in dietary fiber, and rich in essential vitamins and antioxidants (Ruiz et al., 2012; Vatthanakul et al., 2010). However, one major challenge to increasing fruit consumption lies in the perishability and preparation time associated with fresh fruits. Hence, value-added fruit-based products such as fruit leathers play a critical role in reducing post-harvest losses while enhancing dietary diversity.

Mango (*Mangifera indica* L.), a member of the Anacardiaceae family, is widely consumed in India and valued for its rich phytochemical content. It contains mangiferin, quercetin, catechins, anthocyanins, ellagic acid, kaempferol, and various phenolic acids, many of which possess significant antioxidant potential (Masibo and Qian, 2009). Among these, mangiferin is particularly noted for its nutraceutical properties, including anticancer and cardioprotective activities (Raab and Oehler, 1976).

In the context of rising urbanization, changing dietary habits, and nutritional deficiencies termed “hidden hunger,” diversifying diets with functional fruit-based products such as fortified leathers could be an effective strategy to improve micronutrient intake. Therefore, this study aimed to prepare mango fruit leather, fortified with whey protein concentrate, and evaluate its physicochemical and nutritional properties in comparison with raw mango pulp.

2. Materials and Methods

2.1 Materials

Fully ripe mango fruits (for pulp extraction), sugar, pectin, and whey protein concentrate were procured from the local market in Pune, Maharashtra. All processing and analyses were conducted in the Food Process and Product Technology Laboratory, MIT-ADT University, Pune.

2.2 Methods

2.2.1 Preparation of Fruit Leather

Fresh mango pulp was blended with sugar, pectin, and 12% whey protein concentrate. The mixture was heated at 70 °C for 3 minutes to facilitate solubilization. The homogenized mix was poured onto stainless steel trays coated with butter and dried in a cabinet dryer at 60 °C for 6 hours. The methodology followed was adapted from Vijayanand et al. (2000) and Patil et al. (2017), with minor modifications.

2.3 Chemical Analysis

The proximate composition of the mango pulp and fruit leather was determined using standard AOAC (2005) procedures for ash, crude protein, and crude fiber. Moisture and fat content were estimated using the methods of Ranganna (1986), and carbohydrates were calculated by difference.

2.4 Statistical Analysis

All experiments were performed in triplicate. Data were expressed as mean ± standard deviation. Statistical significance ($p < 0.05$) was determined using one-way ANOVA. Analysis was carried out using SAS v9.21, and Microsoft Excel was used for sensory and tabular data processing.

3. Results and Discussion

3.1 Drying Behavior at Different Temperatures

The drying kinetics of mango pulp at 40, 50, 60, and 70 °C indicated a sharp decline in moisture content over time. As shown in Figure 1, moisture reduction was most rapid at 70 °C but resulted in browning and undesirable chewiness, likely due to Maillard reactions and thermal degradation of pigments. Optimal drying at 60 °C for 7 hours yielded leather with acceptable color and moisture content (~19.13%), aligning with findings by Kaur and Godara (2022) and Asabe et al. (2021), who also recommended 50–60 °C as an ideal drying range for fruit leather.

3.2 Nutritional Comparison of Pulp and Leather

3.2.1 Proximate Composition of Mango Pulp

Mango pulp contained 80.63% moisture, 14.39% carbohydrates, 0.61% crude protein, 0.42% fat, 0.79% fiber, and 0.52% ash (Table 1). These values are consistent with previous reports by Pawase et al. (2019) and Chakraborty et al. (2020). Due to its low protein content, whey protein concentrate was used to improve the nutritional value of the leather. Whey protein typically contains over 80% protein (Jangale and Ghanendra, 2013).

ISSN NO: 0130-7673

3.2.2 Proximate Composition of Mango Leather

Post-processing, the mango leather exhibited a moisture content of 19.13%, protein content of 15.89%, carbohydrate content of 58.26%, fiber content of 14.06%, fat content of 1.56%, and ash content of 1.23%. The increase in protein and fiber is directly attributed to whey protein fortification and moisture reduction during drying. These findings are corroborated by Chauhan (2013), who noted nutrient concentration following dehydration.

3.2.3 Mineral Enrichment Through Drying

Drying led to significant concentration of minerals. Calcium content increased from 30.62 to 141.01 mg/100g, potassium from 176.37 to 662.12 mg/100g, magnesium from 20.14 to 54.16 mg/100g, and iron from 1.92 to 2.23 mg/100g. These increases reflect the moisture loss and solid concentration effect inherent to drying (Karabacak et al., 2021). The enrichment of minerals further supports the nutritional efficacy of fruit leathers as functional snacks.

Table 1: Proximate Composition of Mango Pulp and Fortified Mango Leather

(Values expressed as mean ± standard deviation on dry weight basis)

Sample	Moisture (%)	Carbohydrates (%)	Crude Protein (%)	Crude Fat (%)	Crude Fiber (%)	Ash (%)
Mango Pulp	80.63 ± 0.045	14.39 ± 0.86	0.61 ± 0.040	0.42 ± 0.021	0.79 ± 0.020	0.52 ± 0.04
Mango Leather	19.13 ± 0.02	58.26 ± 0.01	15.89 ± 0.40	1.56 ± 0.015	14.06 ± 0.01	1.98 ± 0.01

Table 2: Comparative Mineral Profiling of Mango Pulp and Fortified Mango Leather

(Values in mg/100g of dry sample)

Parameter	Mango Pulp	Mango Leather	SE ±	CD @ 5%
Calcium	30.62	141.01	0.024	0.094
Potassium	176.37	662.12	0.50	0.19
Magnesium	20.14	54.16	0.03	0.11
Iron	1.92	2.23	0.009	0.035

4. Conclusion

This study successfully demonstrated the formulation and nutritional enhancement of mango fruit leather fortified with whey protein. Drying at 60 °C for 7 hours was found optimal for producing leathers with desirable texture, color, and moisture content. The nutritional analysis revealed that the dehydration process substantially concentrated proteins, carbohydrates, dietary fiber, and minerals. Moreover, fortification with whey protein proved effective in significantly improving the protein content, thereby adding functional value. As a result, mango fruit leather can serve as a potential nutrient-dense snack product that addresses hidden hunger, supports dietary diversification, and reduces post-harvest losses of fruits.

References:

Asabe, M., Champawat, P. S., Mudgal, V. D., & Jain, S. K. (2021). Development of dragon fruit leather. *International Journal of Chemical Studies, SP-9*(2), 71–75.

Chakraborty, N., Chakraborty, R., & Saha, A. K. (2020). Fortified and freeze-dried kiwi fruit (Actinidia deliciosa): Quality and sensory assessment. *Brazilian Journal of Food Technology, 23*, 1–16.

Chauvan, R. D. (2013). *Development of fortified mixed fruit bar using whey protein concentrate* [Master's thesis, Anand Agricultural University]. College of Food Processing Technology and Bio-Energy.

Diamante, L. M., Bai, X., & Busch, J. (2014). Fruit leathers: Method of preparation and effect of different conditions on qualities. *International Journal of Food Science, 2014*, 1–12.

Jangale, R. S., & Ghanendra, K. B. (2013). A study on health benefits of whey proteins. *International Journal of Advanced Biotechnology and Research, 4*(1), 15–19.

Karabacak, A. O., Suna, D., & Copur, O. U. (2021). Drying characteristics, mineral content, texture, and sensorial properties of pumpkin fruit leather. *Latin American Applied Research, 51*(3), 193–200.

Kaur, M., & Godara, P. (2022). Various drying processes for fruit leathers preparation and its effects on quality of fruit leathers. *The Pharma Innovation Journal, 11*(5), 2099–2105.

Masibo, M., & He, Q. (2009). Mango bioactive compounds and related nutraceutical properties: A review. *Food Reviews International, 25*, 346–370.

Patil, S. H., Shere, P. D., Sawate, A. R., & Mete, B. S. (2017). Effect of hydrocolloids on textural and sensory quality of date-mango leather. *Journal of Pharmacognosy and Phytochemistry, 6*(5), 399–402.

Pawase, P. A., Veer, S. J., & Chavan, U. D. (2019). Studies on effect of different packaging materials on shelf life of mix fruit bar. *International Journal of Food Science and Nutrition, 4*(5), 156–162.

Raab, C., & Oehler, N. (1976). *Making dried fruit leather* (Fact Sheet 232). Oregon State University Extension Service.

Ranganna, S. (1986). *Handbook of analysis and quality control for fruit and vegetable products*. Tata McGraw-Hill Education.

Ruiz, N. A. Q., Demarchi, S. M., Massolo, J. F., Rodoni, L. M., & Giner, S. A. (2012). Evaluation of quality during storage of apple leather. *LWT—Food Science and Technology, 47*(2), 485–492.

Vatthanakul, S., Jangchud, A., Jangchud, K., Therdthai, N., & Wilkinson, B. (2010). Gold kiwifruit leather product development using quality function deployment approach. *Food Quality and Preference, 21*(3), 339–345.

Vijayanand, P., Yadav, A. R., Balasubramanyam, N., & Narasimham, P. (2000). Storage stability of guava fruit bar prepared using new process. *Journal of Food Science and Technology, 33*(2), 132–137.