

PROCESS OPTIMIZATION OF DRY MANGO PULP CONCENTRATE PRODUCTION FOR FOOD APPLICATIONS

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Abstract

Mango is considered a functional food that contributes both macro- and micronutrients to the human diet, as well as a significant number of bioactive substances. The plant contains abundant amounts of fiber and bioactive chemicals in a variety of sections, including the fruit (pulp, peel, and stone), leaves, and bark. Particularly high in antioxidants, the fruits may have antiviral and anticancer properties in addition to lowering the risk of heart disease. This makes it useful for different application in food industry. This fruit is prone to postharvest wastages due to lack of processing and preservation methods despite rate of rising malnutrition in Nigeria which has led to an increase in the production of functional meals, which offer extra physiological advantages in addition to meeting basic energy and nutritional needs. Therefore, optimization process is required to establish best techniques for processing and preservation of mangoes by processing them into dehydrated food products with prolong shelf life using different drying techniques. Mango concentrate is prepared by extracting the pulp obtained from mature ripe mango. The ripe fruit is processed in excellent conditions by suitable means according to quality standards. Mango pulps concentrate is widely used in the food and beverage industry for juices, nectars, drinks, jams, and many beverages. It is also an important ingredient in the pudding, bakery fillings, ice creams, yogurt, and confectioneries. This review seeks to review ways of optimizing the production of mango pulp concentrate for different food applications.

Keywords: Mango, Mango pulp concentrate, Functional food, Optimization process, Application and uses in food industry.

1.0 Introduction.

In tropical and subtropical regions, mangos (*Mangifera indica* L.) are a popular fruit to cultivate. It belongs to the *Anacardiaceae* family and is known as the "King of all fruits." Over 4.37 million hectares of mangos were produced worldwide in 2017 on an estimated 50.65 million metric tons of mangos (FAOSTATS, 2019). Mangos are being grown for commercial reasons in over 111 countries (Rymbaiet *al.*, 2013). According to Ugeze *et al.* (2012), Nigeria is ranked tenth out of these countries in terms of mango output. Mangos are a popular and beneficial fruit that are rich in antioxidants like vitamin C, carotenoids, and phenolic compounds that have been related to several health benefits, as well as essential nutrients like minerals, fiber, and carbohydrates (Gámez *et al.*, 2017). It is also regarded as a functional food that adds a substantial amount of bioactive compounds together with macro- and micronutrients to the human diet. Studies by Apaket *al.* (2007) and Rymbaiet *al.* (2013) have demonstrated the several ways in which a functional meal can enhance one or more physiological functions and provide anti-illness benefit. The plant's pulp, peel, and stone, as well as its leaves and bark, are rich sources of fiber and bioactive compounds (Rymbaiet *al.*, 2013). Relatively rich in antioxidants, the fruits may also reduce the risk of heart disease and have antiviral and anticancer qualities (Rymbaiet *al.*, 2013).

The process of optimization involves determining the best combination of ingredients to use in a recipe to produce food products that are both highly marketable and of high quality. It also entails improving system performance without adding to costs associated with labour or processing times while preserving the necessary quality attributes of the food throughout the processing and

manufacturing stages. Food process optimization has historically involved holding all other parameters constant while examining the impact of a single parameter modification on a response and/or dependent variable (Bezerra *et al.*, 2008). The incomplete explanation of the entire influence of the factors on the response or dependent variable, as well as the non-consideration of the interacting effects among the variables, are the method's shortcomings. Additionally, using this method necessitates doing more trials, which raises the cost and duration of the study. Optimization studies might be conducted using multivariate statistical methods to solve this challenge. Food process optimization has made use of response surface methodology (RSM), the most widely utilized multivariate statistical technique (Yolmeh *et al.*, 2017). Highlight the gap in knowledge in the subject matter. Thereafter, objectives of the study and justification.

2.0 Materials

The secondary data used to write this review was electronically obtained from Web of Science, Research Gate, Science Direct, and yearly reports examined by different researchers, institutions, and organizations,

2.1 Nutritional composition of mango pulp

Mango pulp good supply of macronutrients such protein and amino acids, carbs, lipids and fatty acids, and organic acids is mango fruit. Mangos also include micronutrients including vitamins and minerals, as well as non-nutrients such carotenoids, phenolic compounds, flavonoids, and other polyphenols, and chlorophyll. Pulp is an important fruit for the human diet; 100 g has an energy content ranging from 60 to 190 kcal (250–795 kJ) (Table 1). Mango fruit's water, non-nutritional, and nutritional contents vary based on the cultivar and a number of pre- and post-harvest variables. The mature mango pulp of the Haden, Kent, Keitt, and/or Tommy Atkins varieties, for instance, contains 83.4 g of water per 100 g of fresh fruit, whereas the cultivar Azúcar from Colombia contains 79.3 g (Corrales-Bernal *et al.*, 2014). This information is based on the USDA's data on nutrient reports.

Table 1: Nutritional compositional Analysis of Mature Mango Fruits Pulps (*Mangifera Indica*. L).

Parameter	Content (g per 100 g of fruit dry weight)
Water	78.9–82.8
Ashes	0.34–0.52
Total Lipids	0.30–0.53
Total Protein	0.36–0.40
Total Carbohydrate	16.20–17.18
Dietary fibre	0.85–1.06
Energy (kcal)	62.1–190

Source: Lebaka *et al.*(2021)

2.2. Health benefit of mango pulp

Research has shown, mango pulps is an excellent source of antioxidants, potassium, and vitamins C and A. Potassium enhances the neurological system and blood quality. Antioxidants and phenolic chemicals are abundant in concentrated mango juice. They specifically help prevent breast, colon, and prostate cancers and have anticarcinogenic effect. Antioxidants support the maintenance of radiant, healthy skin. Vitamin C strengthens the immune system and protects the body from respiratory illnesses, the common cold, and the flu. Vitamin A, cryptoxanthin, alpha- and beta-carotene, and carotene shield our eyes and teeth. Because it is a high source of iron, the doctor advises patients who are anemic or pregnant to consume it. (Lebaka *et al*, 2021)

2.3 Mango pulp concentrate production.

Basically, Lebaka *et al*. (2021), reported that Mango pulp concentrate production involves, cleaning and sorting of ripe mangoes fruits. The sorted and the cleaned mangoes are peeled and the pulp is extracted from the seed and blended. The blended content is then pre-heated at 65 to 70°C 5 mins and standardized, the entrapped air are been removed follow by sterilization at 105°C at 90seconds and thus, Mango pulp concentrate

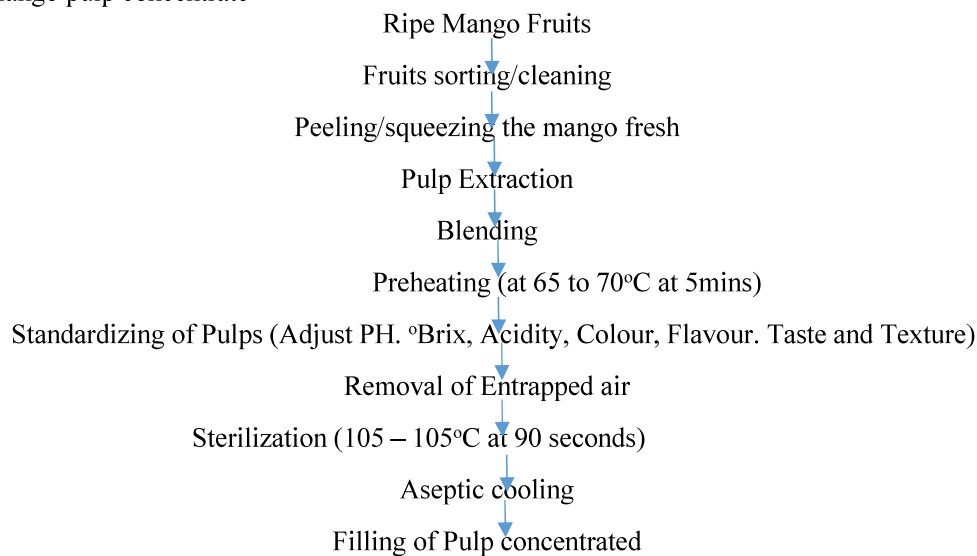


Figure 1.0: Flow chart for the production of mango pulp concentrate

Source: Lebaka *et al*. (2021).

2.4 Uses of mango pulp concentrate

Mango pulp concentrate can be used to make smoothies, milkshakes, and other beverages. It can also be used as a base for making juices and other drinks. Squash, mango juice, and nectar are the three main commercially produced beverages. Because mango pulp concentrate is quite thick, juice is made by adding almost the same amount of water and varying the acidity and total soluble solids (12 to 15% TSS) to taste. Mango nectar has 20% pulp, sugar, and acidity that have been carefully balanced to provide 15% pH and 0.3% acidity in the form of citric acid. Cans are used to package these drinks. According to Ravani and Joshi, they are heated to roughly 85 °C in a heat exchanger, then hotly loaded into cans, sealed, processed, and cooled. Mango squash is preserved in glass bottles with sulfur dioxide (350 ppm) or sodium benzoate (1000 ppm), and it has 25% juice, 45% TSS, and 1.2 to 1.5% acidity (Ravani and Joshi, 2013)

Mango pulp concentrate can be used to make a variety of desserts such as ice cream, yogurt, cakes, pastries, and puddings. It can also be used as a topping for desserts like pancakes, waffles, and ice cream. Mango pulp concentrate can be used to make sauces and dressings for meats, seafood, and vegetables. It can also be used as a base for making marinades and dips. And also, for making

breakfast items like pancakes, waffles, and muffins. It can also be used as a topping for oatmeal, yogurt bread and muffins, Mango pulp concentrate can be used to make main dishes like curries, stews, and braises. It can also be used as a base for making sauces and marinades as well as topping for like cheesecake, panna cotta, and cremebrulee. It can also be used as a topping for ice cream and frozen yogurt (Owino and Ambuko, 2021).

2.5 Optimization process

Optimization is the process of achieving the best possible processing conditions and ingredient combinations for output. It also entails enhancing system performance without raising costs or lengthening processing times, all the while preserving the necessary food quality characteristics during processing and manufacturing. A successful product depends critically on determining the ideal processing conditions and recipe (formulation) for food products that are both highly marketable and of excellent quality. The primary goal of optimization is to improve process efficiency while maintaining cost and time efficiency while producing the greatest results for a system. Food process optimization has historically been carried out by examining the impact of changes to one parameter on a response while maintaining the levels of the others constant (Bezerra *et al.*, 2008). The primary drawbacks of this approach are that the interactive effects between the variables are disregarded, and the full impact of the factors on the answer is not fully explained. Furthermore, this approach necessitates more tests to be conducted, which raises costs and duration (Bezerra *et al.*, 2008). Optimization studies might be conducted using multivariate statistical methods to solve this challenge. RSM, or response surface methodology, is the most widely used multivariate statistical method.

2.6 Surface Response Methodology (RSM)

RSM is a set of mathematical and statistical techniques based on the fit of a polynomial model to the data, which need to represent the behavior of a set of data in order to generate statistical predictions. According to Ghorbannezhad *et al.* (2016), the technique is helpful for establishing, designing, optimizing, and improving processes where a response or responses are influenced by multiple variables. The right experimental design must be chosen in order to determine which treatments should be carried out in the experimental region under study, prior to applying the RSM technique. Experimental designs for quadratic response surfaces, such as Box-Behnken, central composite, and three-level factorial, should be used for this purpose (Bruns *et al.*, 2006).

RSM is a popular and suitable method for streamlining processes in the food business. Some researchers, though, are unfamiliar with this methodology. Inappropriate experimental design, poor independent variable screening, and improper level selection for independent variables are all responsible for this misuse.

2.7 RSM Application in Food Industry

Many studies on the optimization of extraction processes using RSM to improve process condition have been published in the literature in recent years. These studies focus on the extraction of proteins, oils, phenolic compounds, pigments, polysaccharides, hydrocolloids, and other materials. Maceration, ultrasonic-assisted extraction (UAE), microwave-assisted extraction (MAE), supercritical fluid extraction, and enzymatic extraction are a few methods for extracting different bioactive substances (Khazaei *et al.*, 2016). Nevertheless, a number of variables that can be regarded as independent variables in RSM affect extraction yield and process efficiency, such as time, pH, temperature, reagent concentration, irradiation time, flow rate, and solvent to solid ratio. Utilizing various drying techniques, it can also be used to extend the shelf life of fruits and vegetables. This produces dried goods of high quality, taking into account variables like temperature, time, thickness, air speed, vacuum rate, microwave power, osmotic solution concentration, and so on (Burande, *et al.*, 2008). Based on a number of process responses, including water loss, solid gain, final moisture, color, and rehydration ratio, statistical techniques like RSM can present the ideal conditions for the drying process. Functional short dough biscuits, soy-coffee beverages, low-calorie mixed fruit jelly, extruded snack foods, cream, gluten-free bread, pork frankfurters, Iranian white brine cheese, homogenized

infant foods, and sweet potato-based pasta are just a few of the foods whose formulations have been optimized using RSM.

3.0 Conclusion

The continuous increase in population and mal-nutrition has necessitated the demand for improved food security. Optimizing processes for fruits and vegetables for food application helps to enhance product nutritional profile, improve food security and sustainability, improve its functional properties when used as an ingredient, promote economic development and increase health status. Process optimization of mango concentrate presents an opportunity for extending the use of mango beyond domestic use. It is important to note that proper optimization of mango concentrate can enhance the nutritional quality, functional properties and industrial applications making it more versatile and appealing for various culinary purposes. However, improper processing may lead to undesirable changes, affecting the quality of the flour. Thus, it's important to carefully select and control the processing parameters to achieve the desired outcome effectively.

4.0 Recommendation

Further research on more improved techniques for processing and preservation of fruit should be conducted by optimizing various processing and preservation methods, analysis of nutritional composition, non-nutritional composition, bioactive substances sensory attributes, food safety and shelf life studies are crucial to fully exploit the full potential of fruits and vegetables at both domestic and industrial level so as to boost its application in food industry as based for different food products.

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