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Effect Of Different Drying Methods On Ash, Moisture And Protein Content Of Dried Mangoes

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ABSTRACT

Background: Mango is very perishable in nature and also used seasonally, therefore it is of very little use and results in significant losses in the post-harvest stage. Hence, the effective preservation methods are needed to prolong its shelf life and to have availability throughout the year. **OBJECTIVE:** The effect of various drying techniques on proximate composition and biochemical constituents of mango was studied. **METHODS:** Moisture, ash and protein content of dried mango slices during different methods of sun drying, microwave drying, oven drying, and ambient air drying were analyzed via reported AOAC methods. **RESULTS:** Moisture content decreased significantly and nutrients were concentrated in the processed samples as a result of drying. Drying had significant effects on the moisture content and helped in concentration of nutrients with higher ash and protein content in all the processed samples. **CONCLUSION:** Overall, the drying methods had significant effects on mango quality; sun dried mangoes showed least moisture and ash content, whereas oven drying and sun drying methods retained proteins the most.

KEYWORDS:
Mango shelf life, quality, sun-drying, oven drying, air drying, composition

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INTRODUCTION:

Mango (*Mangifera indica*) has been proved helpful in prevention of several diseases including gastrointestinal disorders, cancer, and inflammation. Along with its medicinal applications, mango has been evidenced as important nutritional provider for human health [1]. As compared to other fruits mango has a lower protein content in relation to other macronutrients. For example, Colombia's mango pulp gives 0–0.6% protein while Peru mango covers 1.5 to 5.5% total protein; in other cultivars e.g. Java, mango show 1–2% content, and low total protein content (0.5–1%) is shown by cultivars in India. Mango pulp contain small amount of lipids. Phenolic acids, one of major plants' secondary metabolites constitute part of human diet and show noteworthy importance due to their health benefits and in vitro activities [2].

Dehydration of sliced fruits is generally recommended in order to lessen production loss, which decreases the water activity of the fruits, thus can help in prolonging the shelf-life. Specifically, for dried mangoes, future market depends on an increased quality and availability throughout the the year [3]. Among various methods, the drying process comes out to be one of the significant methods to help in the fruit shelf-life extension; however, quality attributes may be affected. Importantly, phytochemicals such as flavonoids, phenols, carotenoids, alkaloids and volatile compounds have already been reported in mangoes. [4]. These bioactive compounds have significant role in prevention and treatment of inflammatory conditions, Cancer and cardiovascular diseases. Moreover, high fiber and pectin content of mangoes causes reduction of cholesterol deposition, lessens blood lipids, and help in excretion. Drying is the process of transfer of heat as well as mass while decreasing the sample water activity by water evaporation to an unsaturated air stream. [5,6,7]. The main goal in drying food items is to cut the moisture content to prevent microbial spoilage as well as decomposition by yeasts, molds, as well as enzymes. [8,9]. Difference in mango fruit Composition and its processed items from different areas, due to climate and soil variation, postharvest handling, agricultural practices and processing technologies using antioxidant rich foods may deliver various health benefits [10,11].

This study aimed at drying mangoes through different methods i.e. sun drying, air drying, oven drying. Furthermore, biochemical profiling of dried mangoes (via different drying methods) was carried out to assess the comparative nutritional profile. This research was designed as a comparative study to evaluate the biochemical, and nutritional properties of mangoes dried by using different drying methods.

METHODS:

Fresh mango samples (*Mangifera indica*) were collected from local markets. Only uniformly ripened and good-quality mangoes were selected to ensure consistency in results. All the fruits were washed thoroughly in tap water and peeled and sliced into pieces ensuring even slicing of the fruits of uniform thickness (approximately 5–6 mm) thus ensuring even drying during all the treatments. The mango slices once prepared were subjected to four different drying methods.

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SUN DRYING METHOD

Drying was carried out during peak summer months (June, July), with ambient temperatures ranging from 35 °C to 45 °C and relative humidity between 30–40% [12]. Noticeable moisture loss occurred within 2-5 days, and complete drying was achieved when the slices reached constant weight and a leathery texture, typically within 4-5 days. The slices were turned every day to ensure uniform drying and reduce the risk of microbial growth.

MICROWAVE DRYING METHOD

Cuts of mango slices were dried in a domestic microwave oven at fixed power levels. To remove moisture so as to prevent overheating and ensure even moisture removal the drying process was carried out in 10 seconds intervals. It takes 4-8 minutes to dry completely depending on the initial moisture content and thickness of slices. After drying, the sample was cooled at room temperature to avoid condensation.

OVEN DRYING METHOD

Mango samples were subjected to hot-air oven drying using a laboratory convection oven set at a controlled temperature of 50 °C. The drying process was conducted for a period ranging from 15 to 16 minutes, a duration optimized to reduce the moisture content while minimizing thermal degradation of heat-sensitive nutrients and preserving the organoleptic qualities of the fruit. The mango slices were arranged in a single layer on perforated trays to ensure uniform heat distribution and effective moisture evaporation. After the drying cycle, the samples were allowed to cool at room temperature to prevent condensation inside the packaging. The dried mango slices were then immediately sealed in sterile, food-grade zip-lock bags to protect them from environmental moisture and microbial contamination. The samples were stored at root temperature (approximately 25 ± 2 °C) until further analysis. This oven drying method was selected due to its controllability and reproducibility, making it suitable for comparative studies on drying kinetics, quality attributes, and shelf-life evaluation. All of the samples were preserved at room temperature (25 ± 2 °C) in the laboratory for further analyses.

AIR DRYING METHOD

Air drying was performed under ambient conditions (25 ± 2 °C) to simulate traditional low-energy preservation techniques. Mango slices were spread on perforated trays and covered with breathable muslin cloth. Continuous airflow was provided using electric fans to enhance drying efficiency and prevent contamination. The drying process lasted approximately 5–10 days, depending on slice thickness and air humidity. Moisture loss was regularly monitored to minimize microbial growth. Once a leathery texture was achieved, the dried samples were cooled and sealed in sterile zip-lock bags to avoid moisture reabsorption.

Finally, the dried mango slices were ground in the Biochemistry Laboratory using a clean mortar and pestle until a fine and uniform powder was obtained.

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Determination OF Moisture Content

First, the empty dish and lid were dried in the oven at (105 °C) for three hours and then transferred to a desiccator to cool. The empty dish and lid were weighed. About (1 g) of the sample was then weighed into the dish and spread uniformly. The dish containing the sample was placed in the oven and dried for three hours at (105 °C). After drying, the dish with the lid partially covered was transferred to the desiccator to cool. Finally, the dish along with the dried sample was reweighed.

Percentage of Moisture content (%) = (W1-W2÷W1) ×100

W1 weight (g) of sample before drying, W2 weight (g) of sample after drying

DETERMINATION OF ASH CONTENT

The crucible and lid were placed in the furnace at (550 °C) for (6 hrs.) to ensure that any impurities on the surface were burned off. The crucible was then cooled in the desiccator for 30 minutes. After cooling, the crucible and lid were weighed to three decimal places, and approximately (3 g) of the sample was weighed into the crucible. The sample was heated over a low Bunsen flame with the lid half-covered. When fumes were no longer produced, the crucible and lid were placed in the furnace and heated at (550 °C) for (6 hrs.). During heating, the lid was not fully covered. After heating was completed, the lid was placed on the crucible to prevent the loss of fluffy ash. The crucible was then cooled in a desiccator and finally weighed when the ash turned gray [14].

Ash content (%) = Weight of ash /Weight of sample ×100

QUANTIFICATION OF PROTEIN

Quantification of protein was done by Bradford's method [14]. 20 ml of phosphate buffer and added 1 (g) of dried sample then put the sample at the shaker for 3 hrs. then placed into centrifuged machine for 30 minutes. After that collected 0.5 ml (milliliter) of the sample supernatant and added 0.5 ml of phosphate buffer and mixed with 5 mL of Bradford's reagent, and the absorbance was recorded at 595nm against the reagent blank. The protein content of the samples was then determined using a standard curve.

RESULTS AND DISCUSSION

DETERMINATION OF MOISTURE CONTENT

Determination of the moisture content dried by the different drying methods presented in figure 1 demonstrate that Fresh mango sample exhibited the highest moisture content (0.73%), which can be attributed to the absence of any dehydration treatment and the retention of its inherent water content. Drying methods significantly reduced the moisture content which can help effectively in preservation of the fruit. The dried samples demonstrated a marked reduction in moisture levels as a consequence of the applied drying techniques. Microwave-dried mango showed slightly higher moisture content of 0.28% as compared to other methods.

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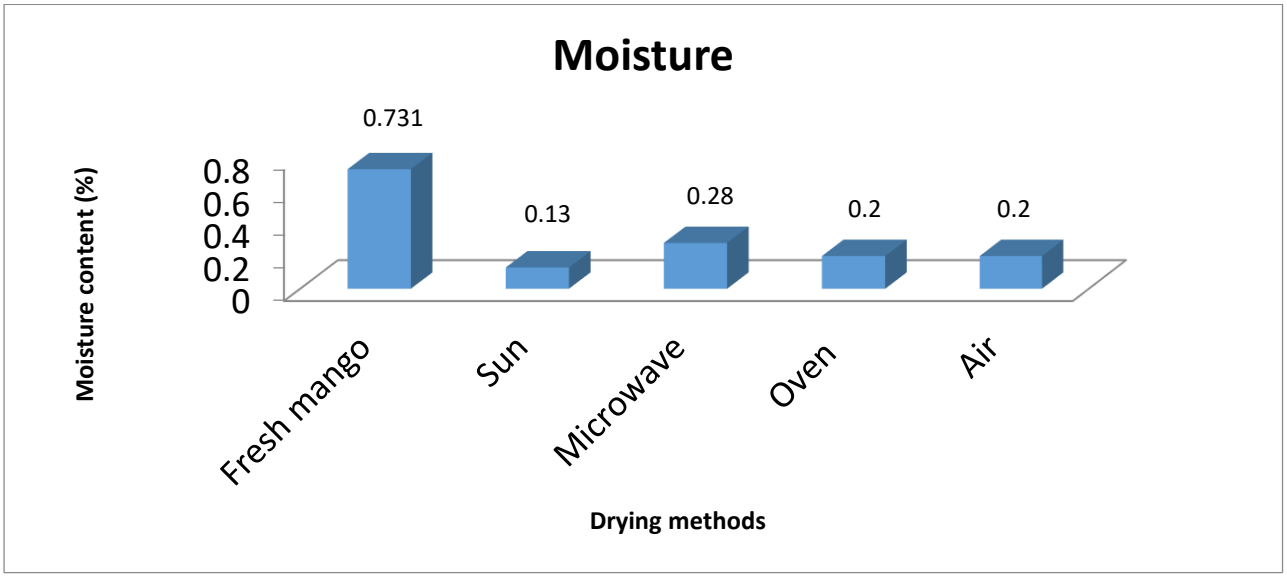
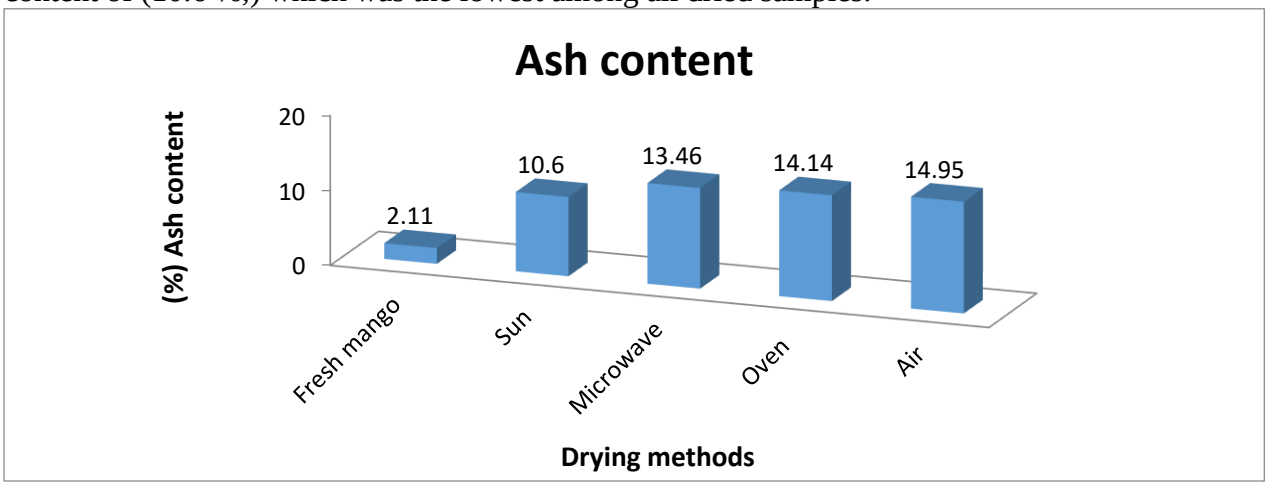


Figure 1. Determination of Moisture Content of dried Mangoes in various Methods

This comparatively higher value among the dried treatments may be associated with rapid volumetric heating, which can result in uneven moisture migration and partial dehydration within the sample matrix [15]. Among all drying methods, sun-dried mango recorded the lowest moisture content (0.13%). The extensive period of exposure to natural light may have allowed the moisture to be removed gradually and evenly, which helped to better dry the moisture. Moderate moisture reduction (0.20%) by both oven drying and air drying methods suggest that effectively reduction in moisture content can be achieved while maintaining controlled moisture evaporation.

DETERMINATION OF ASH CONTENT

The ash content of the fresh mangoes of the present study was found to be (2.11 %), which is the natural mineral composition present in the mangoes without any processing. Among the drying methods, sun-dried mango samples exhibited an ash content of (10.6 %,) which was the lowest among all dried samples.



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.Figure.2. Determination of Ash Content of Dried Mangoes in Different Methods

This relatively lower value may be attributed to prolonged exposure to open environmental conditions during sun drying. Factors such as dust contamination, wind, microbial activity, and fluctuating temperatures may contribute to mineral losses or uneven distribution within the fruit tissues [10]. Microwave drying resulted in an ash content of 13.46%, which was higher than sun drying but lower than oven and air drying methods. Microwave drying utilizes electromagnetic radiation to generate internal heat within the food matrix, leading to rapid moisture removal [11]. This higher ash content (14.14%) was observed for oven dried mango samples, reflecting higher mineral content under controlled drying process

ESTIMATION OF PROTEIN CONTENT

The fresh mango sample exhibited a protein content of (0.78%) which can be attributed to its high moisture content and the natural distribution of proteins within intact plant tissues. Sun-dried mango showed a protein content of (11.098%) which can be linked to gradual dehydration under natural sunlight. The protein content was a little lower in the microwave-dried mangoes than the sun-dried ones (10.42%).

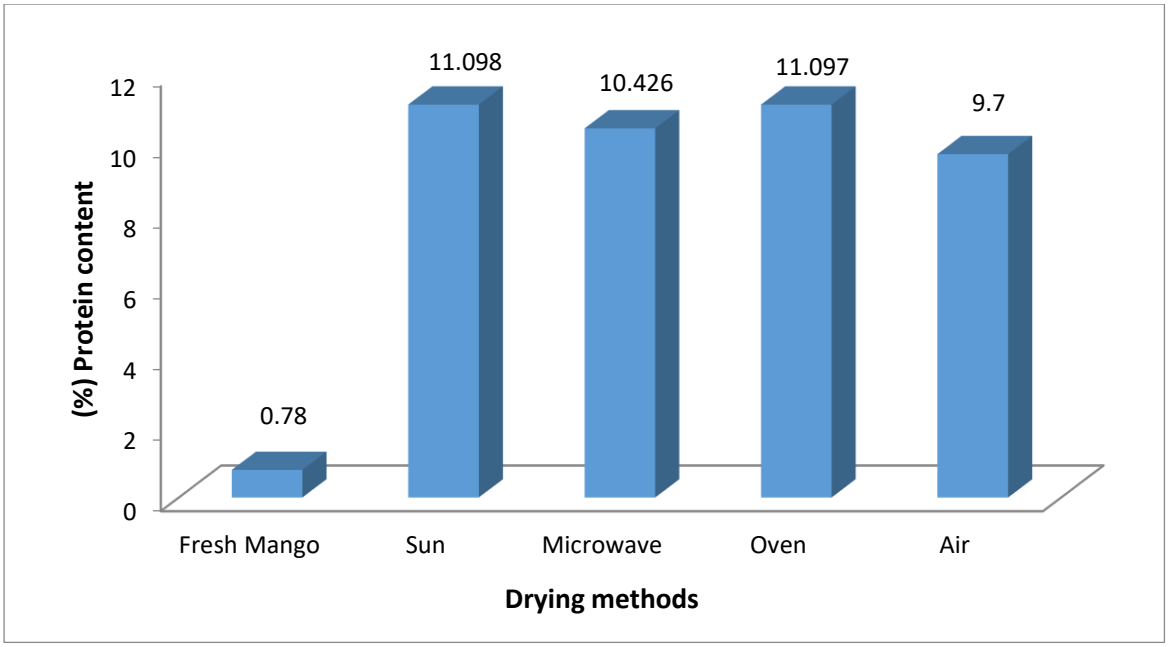

Figure 3. Determination of Protein Concentration of Dried Mangoes in Different Methods

The moisture is dried quickly with the rapid heating mechanism and the thermal exposure does have limitation for long drying time, and thus helps to retain nutrients. The big energy transfer can cause partial denaturation of proteins. However, Protein content in oven dried mango (11.097%) was similar to the sun dried samples. On the other hand, mango that was air dried contained the least protein (9.7%) among the dried

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ones. These prolonged drying times may promote greater enzyme activity and oxidation resulting in protein decomposition or decreased extraction efficiency [15].

CONCLUSION:

Different drying methods influence the moisture content, physicochemical and nutritional properties, shelf stability and sensory characteristics of dried mangoes thus affect their potential applications in food industry and house hold consumpsions. Sun dried mango with lowest moisture is suitable for long term storage due to less moisture which minimizes rapid spoilage and microbial growth. These dried mangos can be used as raw material for fruit based products, snacks for children or as ingredient in traditional foods. Sun drying can be cost effective and energy efficient method for small scale food processing commonly used in rural areas. Relatively higher moisture content in microwave drying method, suggest better retention of sensory characteristics with softer texture, may preserved heat sensitive nutrients and antioxidants due to rapid drying as compare to prolong drying methods. Microwave and oven drying methods with moderate moisture content may be suitable to be used in ready to eat fruit mixes, confectionaries, breakfast or bakery products, cakes, cookies, fruit bars, high quality snack production and dessert formulations. These methods may improve hygienic qualities of the products. While air drying methods may retain mango natural appearance with reduce moisture level effectively. This method is also applicable for minimal processing, naturally produced fruit products. The fresh mango contained more water content and bioactive substances than the dried ones. Drying resulted in lower water content but higher concentrations of proteins. The results indicate that proper drying processes should be considered during the production of dried mangoes because they ensure high consumer satisfaction and quality of the product.

CONFLICT OF INTEREST:

Authors declare no Conflict of Interest:

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