EFFECT OF SOLAR AND OVEN DRYING ON THE NUTRIENT COMPOSITION OF KEITT MANGO (MANGIFERA INDICA L.) PULP

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ABSTRACT

Keitt Mango fruits are popular mango varieties that are dried for consumption using different technologies. The influence of different drying methods on nutritional composition needs to be assessed. This study therefore assessed the effect of solar and oven drying technologies on nutritional composition. Standard methods were used to determine the proximate and mineral composition of Keitt mango pulp. The results showed that whereas solar drying was superior in preserving fat (0.61%), magnesium (134mg/kg) and calcium (39.6 mg/kg), oven drying preserved protein (3.17%), ash (2.60%), carbohydrates (84.25%), energy (414.7 KJ), iron (6.70 mg/kg) and potassium (396 mg/kg) better. The study indicates that since oven drying preserved most of the nutrients, it would therefore be more suitable in drying Keitt mango pulp for use in combating malnutrition.

INTRODUCTION

Mango (Mangifera indica L.) belongs to the family Anacardiaceae. Consumers relish on its flavour and benefit from its vitamin C content (Appiah et al., 2011). Other important benefits derived from mango include income, foreign exchange and employment. Mango can adapt itself to a wide range of climates including both the tropical and subtropical areas. It is popular and consumed around the world both in fresh and processed forms. Mango has been identified as one of the crops with great potential. It was estimated that as at 2009 the global production was 35.04 million tones with India leading with 13.65 million tones (FAOSTAT, 2009).

In spite of the growing mango industry the glut during the major seasons especially in poor rural communities is one of the main causes of low price of fresh mangoes. Since mango is a highly perishable fruit crop it quickly loses its quality after harvest which is at its worst during peak production. The production of dried mango pulp which extends the shelf life has been recommended as one of the most affordable methods of value addition. Mango chip production involves drying mango pulp. Different methods have been used for drying mango in order to produce mango chips of acceptable quality. This includes the use of heat to dry the pulp. It is known that processing including the use of heat can have effect on nutritional quality of food (Chweya and Mnzava, 1997; Kiremire et al., 2010). Since dried mangoes are produced using heat (solar and oven drying) it is important to know how these methods of drying affect the nutritional status of dried mango pulp. The aim of this study was, therefore, to evaluate nutritional quality of mango chips produced using solar and oven drying methods.

MATERIALS AND METHODS

Sample collection

Half ripe Keitt mango fruits were harvested from the same tree at Prudence Farms at Somanya in the

Eastern Region of Ghana. Mango fruits of similar sizes, maturity and stage of ripening were then selected for the study. The fruits were packaged in a well-padded ventilated paper box and transported within 4 hours to the laboratory of the Department of Food Science and Technology (KNUST), Kumasi-Ghana, for the study.

Sample preparation

The fruits were weighed and washed thoroughly with tap water, after which they were reweighed and disinfected with vinegar. The mango fruits were then peeled using a potato peeler, cut into 2 equal halves and seeds removed. The pulps were then sliced into chunks (2cm x 4cm x 0.5cm according to the method of Appiah et al. (2011) with slight modification. The chopped pulps were thoroughly mixed and divided into two. One half was solar dried for 24 hours (36-40 °C daily temperature range) while the other half was dried in an oven at 60°C for 11 hours. The dried pulps were then placed in airtight plastic bags prior to analysis.

Determination of Proximate and mineral composition

Proximate determination was carried out at the Biochemistry laboratory of KNUST whilst mineral analysis was done at the laboratory of Ashanti Goldfield in Obuasi, Ghana. Proximate composition and mineral analysis were carried out as recommended by AOAC (1990). The parameters determined were moisture, protein, crude fat, crude fibre, ash, carbohydrate, Fe, P, Ca, Zn, Mg and K contents.

Statistical analysis

Analysis of variance was carried out on the data using GenStat (3rd edition). Least significant difference at P= 0.05 was used to separate unequal means.

RESULTS AND DISCUSSION

Proximate Composition of Keitt Mango pulp

The moisture content of the fresh mango pulp was reduced by 772% from 80.44% to 10.42% by the use of solar drying, whereas oven drying resulted in 974% decrease from 80.44% to 8.26% (Table 1). The results suggest that oven drying was more efficient in reducing the pulp moisture to a greater extent than solar drying. The higher decrease observed in the oven-dried pulp could be attributed to faster drying and pronounced drying (Brenn dorfer et al., 1987). Since the oven dried pulp had lower moisture content, it was consequently expected to have longer shelf-life than the solar dried (Oduro et al., 2009).

Oven drying of Keitt mango pulp resulted in significantly higher protein content (3.17%) than solar drying (2.82%) with fresh pulp recording the least (0.60%). This observation was similar to that reported by Abugre et al. (2011) that solar drying preserved protein better than solar drying. The lower protein content in the solar dried pulp could be attributed to slower drying which possibly enhanced proteolysis. The result indicates that oven drying should be the method of choice when protein

<table>
<thead>
<tr>
<th>Pulp treatment</th>
<th>Moisture</th>
<th>Crude Protein</th>
<th>Crude fat</th>
<th>Crude fibre</th>
<th>Ash</th>
<th>Carbohydrate</th>
</tr>
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<tbody>
<tr>
<td>Fresh</td>
<td>80.44±0.20</td>
<td>0.60±0.10</td>
<td>0.25±0.03</td>
<td>0.72±0.04</td>
<td>0.34±0.02</td>
<td>18.27±0.41</td>
</tr>
<tr>
<td>Solar dried</td>
<td>10.42±0.10</td>
<td>2.82±0.20</td>
<td>0.61±0.02</td>
<td>3.00±0.50</td>
<td>1.87±0.10</td>
<td>80.78±0.30</td>
</tr>
<tr>
<td>Oven dried</td>
<td>8.26±0.02</td>
<td>3.17±0.07</td>
<td>0.42±0.01</td>
<td>3.11±0.04</td>
<td>2.60±0.03</td>
<td>84.25±1.04</td>
</tr>
<tr>
<td>LSD (0.05)</td>
<td>0.259</td>
<td>0.270</td>
<td>0.043</td>
<td>0.580</td>
<td>0.122</td>
<td>1.338</td>
</tr>
</tbody>
</table>
preservation is of interest.

The fat contents of the mango pulps were generally concentrated through drying from 0.25% in the fresh pulp to 0.42% and 0.61% in oven and solar drying respectively. The differences in crude fat content were significant. Fat is known to contribute energy (Kummerow, 1960) and palatability (Aiyesanmi and Oguntokun, 1996) to foods. Solar drying should, therefore, be a method of choice when higher energy level is required. The higher fat content in the solar dried pulps could result in improved palatability of the dried mango pulps.

The results of the study showed that there was a 4.17 times concentration of crude fibre from 0.72% in the fresh pulp to 3.00% in the solar dried as against 4.32 times concentration (3.11%) in the oven dried. The faster rate of drying in the oven compared to the solar dried could result in reduced fibre breakdown reflecting in the higher fibre content of the oven dried pulp. Intake of fibre has been reported to improve stool passage in the digestive tract by providing bulk, reducing stool transit time (Johnson and Marlett, 1986) and reduced colon cancer incidence (Shankar and Lanza, 1991). The oven dried pulp would therefore be more useful in providing the health benefits derivable from fibre since it had higher fibre content.

The ash content of the oven dried pulp (2.60%) was higher than the solar dried (1.87%). These represent 765% and 550% increases on the ash content on the fresh pulp (0.34%). The lower ash content could be as a result of dripping of moisture containing dissolved salts from the pulp since minerals essentially constitute ash (McClements, 2003). The higher ash content of the oven dried pulp is indicative of its higher ability to preserve minerals in the mango pulp than solar drying.

As expected the carbohydrate content of the oven dried pulp (84.25%) was higher than in the solar dried (80.78%) and fresh pulp (18.27%). Since the oven drying dried the pulp faster than solar drying, it probably had less extensive fermentation leading to a reduced use of carbohydrates (sugars) during drying. Since carbohydrates are the major energy sources in foods, it was not surprising that solar drying which had higher carbohydrate content (84.25%) also provided higher energy (417.7 KJ) than solar drying (406.1 KJ).

The results have shown that oven drying is superior to solar drying in preserving proximate and energy components of Keitt mango pulp since it resulted in higher crude fibre, ash, carbohydrates and energy content.

**Mineral composition of Keitt mango pulp**

The mineral composition of the Keitt mango pulps have been presented in Table 2. Potassium was found to be the predominant mineral in the pulp of Keitt mango. Fresh mango pulp had significantly higher potassium content (752mg/kg) than the oven-dried (396mg/kg) and solar-dried (345mg/kg). The observed decrease in potassium content during drying could be due to fluid dripping. Soluble potassium compounds (Mayer and Avi-Dor, 1970) in fruits probably leached from the pulp as the pulp juice dripped during drying. Solar dried pulp had lower potassium content since it took longer time in drying than the oven resulting in more extensive juice drip. If Keitt mango is to be dried, the method of choice for preserving potassium should be the use of oven. The high Potassium content suggests it could be suitable for ameliorating hypertension when it is consumed (Whelton et al., 1997).

Unlike potassium, magnesium content increased from 31.5 mg/kg in the fresh pulp to 103 mg/kg in the oven dried pulp whereas the solar dried had 134 mg/kg. Magnesium has been reported to be useful in promoting nerve transmission (Ferrao et al., 1987). Although, consuming oven dried pulp would help supplement by contributing to the daily recommended intake of 320-420mg/day for adults of over 31 years old (National Institutes of Health, 2011a), higher levels could be provided in solar dried Keitt mango pulp.
Table 2

<table>
<thead>
<tr>
<th>Pulp treatment</th>
<th>Iron</th>
<th>Phosphorus (x 10⁻¹)</th>
<th>Calcium</th>
<th>Magnesium</th>
<th>Potassium</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fresh</td>
<td>0.85±0.01</td>
<td>6.67±0.00</td>
<td>8.99±0.045</td>
<td>31.50±0.7638</td>
<td>752.00±2.00</td>
</tr>
<tr>
<td>Solar dried</td>
<td>4.40±0.20</td>
<td>3.33±0.00</td>
<td>39.60±0.30</td>
<td>134.00±2.00</td>
<td>345.00±5.00</td>
</tr>
<tr>
<td>Oven dried</td>
<td>6.70±0.20</td>
<td>200.00±0.01</td>
<td>8.16±0.06</td>
<td>103.00±3.00</td>
<td>396.00±6.00</td>
</tr>
<tr>
<td>LSD (0.05)</td>
<td>0.327</td>
<td>0.012</td>
<td>0.357</td>
<td>4.251</td>
<td>9.300</td>
</tr>
</tbody>
</table>

Whereas there was a concentration of calcium from 8.99 mg/kg in the fresh fruit to 39.6 mg/kg in the solar dried, oven drying resulted in a decrease to 8.16 mg/kg. The results suggest that consuming solar dried Keitt mango pulp would help meet the recommended calcium intake of 1000mg/day for adults of between 19 and 50 years of age (National Institutes of Health, 2011b) more than the oven dried.

As regards, iron content oven drying resulted in higher iron content (6.70 mg/kg) than solar drying (4.40 mg/kg) and fresh pulp (0.85%). It is, therefore, expected that oven dried Keitt mango pulp would be more useful in alleviating anaemic conditions especially in rural poor communities where iron deficiency is prevalent. Only trace amounts of phosphorus and zinc were found in the Keitt mango pulp, suggesting they are not important sources of the minerals.

CONCLUSION

This study has shown that different drying technologies have varying effect on proximate and mineral composition of Keitt mango pulp. Whereas oven drying was superior in preserving protein, fibre, ash, carbohydrates, energy, iron and potassium, solar drying preserved fat, magnesium and calcium better. Generally, oven drying showed superior capacity in preserving the nutritional composition of Keitt mango pulp and it should be the method of choice.

REFERENCES


