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## **Enhancing Income of Rural Women through Processing and Value Addition of Raw Mango Fruits in Malihabad, Uttar Pradesh: A Case Study**

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### **Authors' contributions**

*This work was carried out in collaboration between all authors. Author PSG designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Author AKV performed the statistical analysis. Author SCY did the data collection, Author DKS managed the literature searches. Author MM edited the manuscript. All authors read and approved the final manuscript.*

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### **Case Study**

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### **ABSTRACT**

Mohammad Nagar Talukedari, a village in tehsil Malihabad of Uttar Pradesh is famous for the production of dried mango slices locally known as *Khattai*. Women folk are involved in this practice using old age technology. Some of the problems we identified were inferior quality of produce, inadequate drying, inefficient peeling and predominance of middlemen in the marketing channel. A total number of 60 rural women from small, marginal and landless farm families were roped in for hands on training to hone their skill for improved dry mango slice production. Our intervention included an improved method using mango peeler, solar dehydrator, preservative and marketing of produce through an NGO. This led to the enhancement of income to the tune of 50.98% in small, 50.61% in marginal and 47.67% in landless farm families. Use of mango peeler enhanced 4.50% slice recovery and reduced 26.49% time in peeling over the traditional knife. The solar dehydrator enhanced 8-10°C temperature over ambient temperature which helped in fast and uniform drying.

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The dried mango slices produced through improved method contains lower moisture (8.44%) and non enzymatic browning (0.136) whereas high titrable acidity (21.33%) and total phenol (0.718 g/100 g) as compared to traditional method.

**Keywords:** Raw; mango; processing; value addition; income; rural; women.

## 1. INTRODUCTION

Malihabad tehsil of Uttar Pradesh is internationally acclaimed for its delicious mango variety Dashehari which occupies around 25,000 ha areas. Mango cultivation remains a major source of livelihood for most of the farmers in this area. Maximum numbers of small and marginal holdings exist in the states of Uttar Pradesh, Bihar, Andhra Pradesh and Maharashtra [1]. Malihabad area is dominated by small and marginal mango growers in Uttar Pradesh. The profitability in mango cultivation is declining owing to change in pest and disease dynamics, unorganised marketing, lack of marketing intelligence and mango based processing units, market glut, low prices and high post harvest losses. Under these circumstances, small and marginal mango grower is facing increased vulnerability. In the era of globalisation, liberalisation and market competitiveness, value chain led marketing and value addition through processing is imperative for enhancing the income of small and marginal farmers particularly women [2].

Dust storms during mango fruiting season results in dropping of 15-20% raw fruits in mango growing regions of Uttar Pradesh. The magnitude of fruit drop depends on severity of storm. Around 10-12% fruits get cracked due to improper harvesting and eventually become unfit for marketing. Conventionally, rural women collect these dropped and cracked fruits and make dried slices using traditional methods of slicing and drying. Dried slices locally known as *Khataai* are inferior in quality and sold to local middleman at very low prices (Rs. 60-70/Kg). In order to augment income of farm women, a new improved method of processing raw mango into dried slices and marketing was introduced in village Mohammad Nagar Talukedari of Malihabad.

Earlier studies carried out in cluster Pedawada of district Bastar, Chhattisgarh under National Agriculture Innovation Project (NAIP) project suggested that little primary processing and collective marketing of tamarind has significantly improved the income of landless and marginal

farmers [3]. Another study on processing, value addition and organised marketing of Malta Orange results in improved livelihood and community-based enterprise development in Chamoli district of Uttarakhand [4].

## 2. MATERIALS AND METHODS

A baseline survey was conducted under Farmer FIRST project among 278 farmers of the selected Mohammad Nagar Talukedari. The data clearly revealed that most of the farmers in the selected village are marginal (67%) followed by landless (26%) and small (7%). The major sources of livelihood are mango production, dry mango slice production, vegetable cultivation and agriculture labour. Dry mango slice production remains a major stay for livelihood of landless and rural women. Two problems were identified during focused group discussion viz., inferior quality of dried mango slices, unorganised marketing and predominance of middle men in marketing channel resulting in low profit to farmers. Several farmer-scientists interactions from February to June, 2017 led to the formation of three groups viz., landless, marginal and small farm families with the help of local administrative bodies and an NGO, Society for Conservation of Mango Diversity (SCMD), Kasmandi Kalan for mobilisation of farmers. A total number of 60 rural women were roped in for hands on training to hone their skill the identified rural women. The skilled rural women were provided with mango peeler specially designed for mango, sealing machine, packaging material, solar dehydrator for efficient and hygienic drying of slices and preservative to improve colour and quality of produce. The produce was packaged in food grade poly packs and sealed. Society for Conservation of Mango Diversity (SCMD), Kasmandi Kalan then procured dry mango slices from the rural women and sold it to people through mobile mango van, *aam mahotsav*, mango shows and in the local market. The mango dry slices were tested against different physical and biochemical parameters. Moisture content was determined by drying a known weight of the sample in an oven at  $60 \pm 2^\circ\text{C}$  to a constant weight [5]. The results were expressed as percent moisture content. Titratable acidity



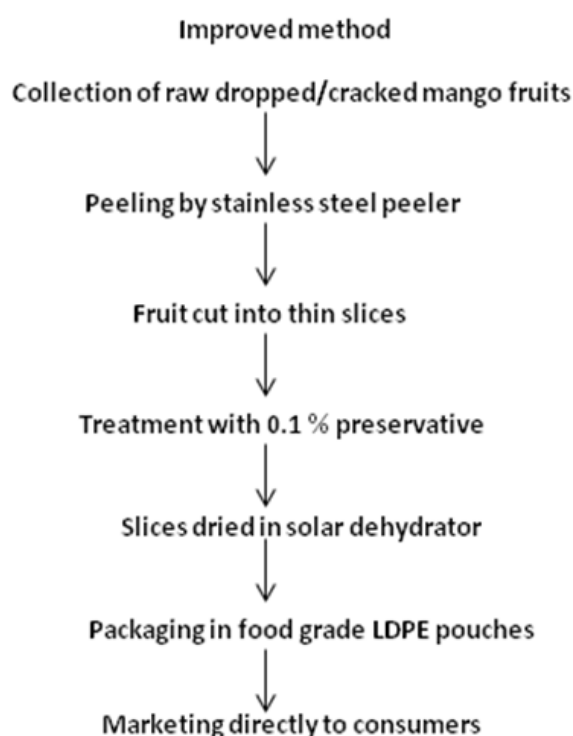
**Fig. 1. Flowchart of traditional process of dry slices production and marketing**

was estimated by titrating a known aliquot of the sample against the standard sodium hydroxide solution using phenolphthalein as an indicator [5]. Non-enzymatic browning was measured in terms of optical density at 420 nm of an aliquot of 60% alcoholic extract [5]. Total phenols were determined by Folin-Ciocalteu method [6]. The data obtained during the course of study was analysed using the statistical software developed by Sheoran et al. [7]. The procedures followed in improved and traditional method are depicted in Fig. 1.

### 3. RESULTS AND DISCUSSION

#### 3.1 Effect of Mango Peeler and Solar Dryer

The process of peeling raw mango is time consuming. However, when mango peeler having rotating blade was used for peeling raw mango fruits, slices recovery enhanced up to 4.50% over traditional knife. The time taken for peeling of equal quantity of raw mango fruits by mango peeler was 26.49% lower than traditional knife (Fig. 3). The recovery of slices after removing stone and peel was 72.3% in peeler



**Fig. 2. Flowchart of improved process of dry slices production and marketing**

while in traditional knife recovery of slices was 69.2%. Since peeler had a rotating blade it removes thin layer of peel without damaging pulp. Solar dryer was found effective for fast, uniform and hygienic drying of slices as compare to sun drying because in solar dryer, 8-10°C higher temperature was observed as compare to ambient temperature. The solar dried slices contain 8.44% moisture whereas sun dried slices contain 10.45% moisture (Table 1). The moisture content directly related to the quality of the produce. Earlier, Singh et al. [8] observed 15°C higher temperature over ambient in low cost solar tunnel dryer useful for drying of aonla slices in western Rajasthan.

#### 3.2 Physical and Chemical Properties of Slices Prepared through Improved Method

It is evident from Table 2 that physical and biochemical properties of dried mango slices processed through improved method differed significantly in terms of yield as well as quality parameters. The dried product yield, moisture content and total phenol content were differing highly significant in improved processed product

**Table 1. Physical and biochemical parameters of raw mango dried slices prepared from improved and traditional method**

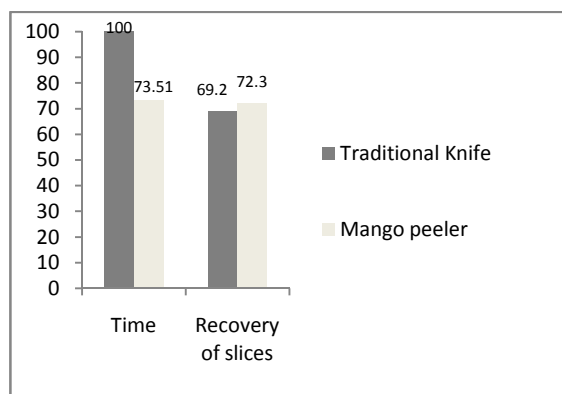
Parameters	Improved method	Traditional method	Mean difference	t value
Product yield (%)	19.95	16.67	2.59	9.64**
Moisture (%)	8.44	10.45	2.10	6.88**
Titration Acidity (%)	21.33	18.36	2.97	11.30*
Total Phenol (g/100 gm TAE)	0.718	0.473	0.245	7.97**
Non enzymatic browning (OD 440 nm)	0.136	0.155	0.0187	2.96*

\*\*P&lt;0.01 \*\* = significant at 1%, \* = significant at 5%, TAE = Tannic Acid Equivalent

**Table 2. Income from dried mango slices production through Improved and Traditional method across farm women categories**

Farmer category	Improved method (n = 60)			Traditional method (n = 60)			Mean difference	% increase in income over traditional method	t value
	Gross income (Rs)	Gross cost (Rs)	Net income (Rs)	Gross income (Rs)	Gross cost (Rs)	Net income (Rs)			
Land less	44460	20748	23712	35126	19068.4	16057.6	7654.40	47.67%	9.68**
Marginal	26730	12474	14256	20706	11240.4	9465.6	4790.60	50.61%	16.54**
Small	18045	7619	10426	15102.5	8198.5	6904	3520	50.98%	8.30**

\*\* = significant at 1%

**Fig. 3. Effect of mango peeler on slice recovery and peeling time**

and traditional product. The yield of dried product was higher (19.95%) in improved method because of higher recovery of slices obtained during peeling. The slices produced through improved process showed significantly lower non-enzymatic browning as compared to traditional slices due to use of mango peeler and preservative treatment. Our results were corroborated with the findings of Mwamba et al. [9] where the authors observed 26 per cent drying yield of raw mango slices dried in solar dehydrator with good sensory parameters.

### 3.3 Income from Dry Mango Slices Production through Improved and Traditional Method

Two groups were chosen to compare the impact of improved method on income enhancement. The first group consists of 30 trained women in three categories (Landless, marginal and small) provided with technology and accessories. The second group consists of 30 women from same village in three different categories revealed that the net income of landless rural women intensively involve in dried slices production increased by 47.67% using improved technology compared to the traditional technology. Similarly, the income of marginal women farmers rose to 50.61% by improved technology. The income of small farmers also enhanced by 50.98% compared to traditional technology. The income of small and marginal farmers was at par. However income of landless farmers was less than the other categories because they have to buy raw mango fruits from market. Singh et al [10] found same results, where farm women income enhanced significantly through formation of women group, trainings, processing and value addition of mango in Unnao district of Uttar Pradesh. Chaudhary et al. [4] reported that income of small and marginal farmers almost tripled ( $t = \text{statistic} -2.91$ ) following training for good orchard management, organise marketing and value addition in Chamoli district of Uttarakhand. Schreinemachers, et al. [11] quantified the effect of training in off-season tomato production on the income small and marginal holder vegetable farmers in southwestern Bangladesh. They found that the training of small and marginal holder vegetable farmers in off-season tomato production was dramatically improve their crop output (+39%), profitability (+50%) and net household income (+48%) in the kharif season.

## 4. CONCLUSIONS AND POLICY IMPLICATIONS

Mango being the major source of livelihood in Malihabad region of Uttar Pradesh requires improvement in traditional knowledge of processing and value addition by demonstration and trainings. Improved dried mango slice production technology introduced in Mohammad Nagar Talukedari village enhanced income of rural women from 47.67 to 50.98 per cent. Further income can be augmented by converting these dried slices into raw mango powder.

On the basis of above findings following suggestions emerged for implementation by state/central functionaries

- In rural areas of Malihabad region emphasis should be given on processing, value addition of raw and ripe mango to reduce post harvest losses as well as for income generation and nutritional security. It is possible only through on farm demonstrations, trainings, formation of self help groups, marketing linkages and financial support.
- The facility for processing, packing and quality testing must be made available to the rural population in which sophisticated machinery is required and cannot be procured at individual level.
- A small scale *amchur* production industry should be established in the region so that raw mango dried slices can be purchased from rural women.
- Initiatives must be taken by State and Central government for marketing of processed products prepared by rural people.

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## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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