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Assay of valuable components in by-products of mango industry in Chittoor district, Andhra Pradesh

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Abstract
The Fruit Processing Industrial by-products are sensitive to environment and cost effective to manage by the processing industries. Mango processing yield about 40-50% of by-products which include damaged fruits, mango seeds, peels and fibrous waste. As these by-products containing valuable components, the present study focused to analyze the valuable components in the stage-II by-products. The stage-II fibrous waste of mango processing industry was collected randomly from the five mango processing industries located in Chittoor District, Andhra Pradesh. The Traditional Sun Drying and Hot air Oven Drying technique were applied to preserve byproducts. The Valuable components are analyzed by following AOAC (1990) procedures. The results of the analysis showed presence of Fiber, Protein, Carbohydrates, Phosphorous and Vit.C and minerals like Calcium, Cadmium, Cobalt, Chromium, Copper, Iron, Magnesium, Nickel, Selenium and Zinc. The analysis of Valuable components in by-product sample exposed to different drying techniques showed Moisture, Protein, CHO, Crude fibre in the range of 10.90 – 14.40 g/100g, 2.20 – 3.63g/100g, 81.10 – 83.14g/100g and 4.89 – 5.54 g/100g in Sundried sample and 8.23-8.81g/100g, 2.81 – 3.51g/100g, 78.57 – 80.86 g/100g and 5.09 - 6.12 g/100g in Hot air oven dried samples respectively. The by-products can be processed and may further used in other products as they contain valuable nutrients.

Keywords: mango byproducts, drying, valuable components

1. Introduction
Fruits and Vegetables industry produces large volumes of wastes, both solids and liquid, resulting from the production, preparation and consumption of its products. Processing of fruits and vegetables produces two types of waste - a solid waste of peel/skin, seeds, stones etc., a liquid waste of juice and wash-waters. In some fruits the discarded portion can be very high (e.g: mango 30-50%, banana 20%, orange 30-50%). These wastes pose increasing disposal and potential severe pollution problems and represent a loss of valuable biomass and nutrients. Beside their pollution and hazard aspects, in many cases, Fruits and Vegetables processing wastes might have a potential for conversion into useful products of higher value as by-product, or even as raw material for other industries, or for use as food or feed after biological treatment.
Andhra Pradesh is one of the states, where in large variability is seen for the varieties. Propagation of local types was undertaken mainly by seeds has resulted in enormous variability for different traits. Chittoor in Andhra Pradesh is one of the regions wherein commercial cultivation of many varieties like Totapuri, Neelum, Banganapalli, Alphonso and Kalapadi is being cultivated. Due to overemphasis on the cultivation of certain varieties viz., Totapuri, which has demand from the processing industry, local indigenous varieties meant for table, pickling, juice or other products are becoming extinct.
Mango can be characterized as having high sugar content (15-20%) and a low acid content (0.2-0.5%) which would account for mangoes sweet, pleasant, characteristics. Nutritionally mangoes are a good source of vitamin A, C and fibre. The majority of mango production is consumed fresh and about 1-2% of the production is processed to make products such as juices, concentrates, nectars, jams, fruit bars, jelly, powders, flakes and dried fruits (Berardini *et al*., 2005; Jedele *et al*., 2003) [3, 8].
Mango processing yield about 40-50% of by-products (dela Cruz Medina *et al*., 2002; Sruamsiri *et al*., 2009) [4, 11] include damaged fruits, mango seeds, peels and fibrous waste which represents from 35-60% of the whole fruit (depending on variety) (Larrauri *et al*., 1996) [10]. Processed mango products are among the major good exported, hence several million tons of mango by-products are produced annually from mango pulp processing industries with an estimated yield of 1,50,000 to 4,00,000 tons of wastes worldwide from mango processing. This may cause environmental problem in the vicinity of the plants. The use of these wastes as livestock feeding and as a bio-fertilizer is a way of reducing environmental concerns (Jedele *et al*., 2003; El-Kholy *et al*., 2008) [8, 5]. Yet, this is not an adequate way of using mango processing waste. Several studies have shown that the content of phyto-chemical compounds is higher in mango waste with respect to the edible tissue. The total phenolics and flavonoid contents were higher in the by-products as compared to the final products.
Keeping in view of the above whole scenario, an attempt has been done to estimate the valuable components adhere in mango fibrous pulper waste from stage-II of mango processing and development of value added products from by-products using scientific and technological methods.

2. Materials and Methods
2.1 Materials
During mango processing into pulp there are three by-

products obtained from two stages Stage-I: Peels and Stones and Stage-II: fibrous waste. The present study was focused on the stage-II of mango processing byproducts of mango industry. For the study five mango processing industries were randomly selected which process Totapuri Mango Pulp for their domestic and export customers. A representative sample of by-products at stage-II was collected hygienically from these industries and coded as MI-1 (Mango Industry - 1), MI-2, MI-3, MI-4 and MI-5 respectively from Chittoor district, Andhra Pradesh.

2.2 Methods

2.2.1 Collection of by-products from Stage-II of Mango processing

The collection of by-products was carried in selected mango processing industries in Chittoor district which processes Totapuri Mango Pulp and Concentrate to their domestic and export customers with the average capacity of 100-120 MT/day.

During mango pulp processing a representative byproduct sample of pulper waste at stage-II was collected hygienically without any contaminants and preserved in refrigerator at 5 ±1 °C. The byproduct samples have been transferred in thermally isolated container to Food Chemistry Laboratory, Dept. of Home Science, Sri Venkateswara University, Tirupati for further analysis.

The mango byproducts contain moisture content and sugars hence it may spoil easily. Drying is the best method to preserve the stage-II byproduct. In the present study traditional sun drying and conventional hot air oven drying techniques are adopted as they are cost effective.

2.2.2 Sun Drying

Mango by-product sample has spread into 3-5mm layer upon the 100 micron poly-ethylene film for drying. The poly film placed on the drying tray. Drying tray was dried in sun and care was taken to avoid any physical contaminants like dust, dirt, insect infestation etc. The optimal range of temperature was 38 ± 2 °C and humidity was 35 ± 5 mm hg. Drying was allowed during day time, trays are removed and stored safely during night time. As this traditional Sun drying depends upon the Sun light, by-products sample has been taken 27±2 hrs for drying. Then the dried by-product samples are separated from poly film to pack in poly ethylene air tight pouch and preserved at dark, dry and cool place to avoid enzymatic and oxidative reactions. These dried samples used further for analysis and utilized in product developments.

2.2.3 Hot air oven drying

Mango by-product sample has spread into 3-5mm layer upon the trays which are suitable for drying. Spreaded poly film placed on the drying tray. Trays have been placed in laboratory Hot air Oven (Technico Pvt. Ltd.) at 60 ± 2 °C temperature for 12 ± 1 hrs. Then the dried by-product samples are separated from poly film to pack in poly ethylene air tight pouch and preserved at dark, dry and cool place to avoid enzymatic and oxidative reactions. These dried samples used further for analysis and development of products.

2.3 Assay of nutrient components

Moisture content, Ash, Protein, Crude fibre, Total fat and Carbohydrates were determined according to AOAC (1990) [2] at Food Chemistry Laboratory, Food Technology, Dept. of Home Science, Sri Venkateswara University, Tirupati.

3. Results and Discussion

Chittoor district is the most popular district in Andhra Pradesh for commercial mango cultivation and processing. About 65 processing units are established as Large, Medium and Small scale industries according to their production capacities at Chittoor dist., to process tropical fruits and vegetables. Mango is the most commonly and majorly processed fruit in these industries. A visit was conducted to five industries purposively selected to know amount of stage-II byproduct produced. The selected industries are coded as MI-1, MI-2, MI-3, MI-4 and MI-5.

3.1 Nutrient Composition of by-product

Moisture content in Sun drying and Hot air oven drying samples are 77.40 ± 0.316 g/100gm and 78.44 ± 0.261 g/100gm respectively. Moisture content was more in stage-II by-product due to the fibrous nature and the traces of fruit pulp. The Crude fibre content was 5.19 ± 0.269 g/100gm in Sun dried and 5.68 ± 0.408 g/100gm in Hot air oven dried sample (Table no.1). The amount of ash ranged from 1.66±0.10 g/100gm to 2.02±0.11 g/100gm and 1.81±0.12 g/100gm to 2.33±0.09 g/100gm in Sun dried sample and Hot air oven dried sample respectively. (Fig.1). Ajila *et al*., (2007) [1] estimated moisture in mango peels of Raspuri (Raw & Ripe) and Badami (Raw & Ripe) was found 66 to 75 g/100g and Crude fiber was found 1.16 % to 3.0 %.

Table 1: Nutrient Composition of by-product: (Units: g/ 100 gm)

S. No.	Parameters	Moisture (Mean ± SD)	Protein (Mean ± SD)	Total fat (Mean ± SD)	Carbohydrates (Mean ± SD)	Crude Fibre (Mean ± SD)
1	Sun Drying	12.64 ± 1.59	3.23 ± 0.58	0.38 ± 0.16	81.95 ± 1.02	5.19 ± 0.27
2	Hot Air Oven Drying	8.59 ± 0.22	3.22 ± 0.30	0.33 ± 0.07	79.49 ± 0.96	5.68 ± 0.41

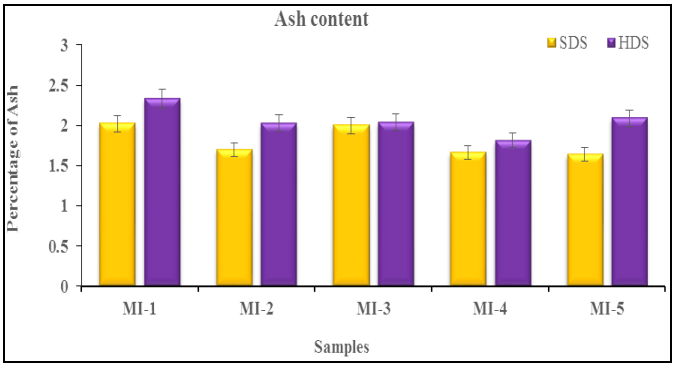

Fig 1: Ash content of mango byproduct subjected for drying methods Sun drying (SDS) & Hot air oven drying (HDS)

The protein content was estimated by using the kjeldhal method of nitrogen determination. The protein content in the byproduct of sun dried sample was 3.63, 3.43, 3.50, 2.20 and 3.38 g/100gm and the protein content in hot air oven dried samples was 2.81, 3.31, 3.44, 3.01 and 3.51 g/100gm respectively. The mean protein content for sun dried sample is 3.23±0.582 and 3.22±0.297 g/100gm for hot air oven dried sample, which is distinctly showing that low content of protein. These results are in accordance with Onuh (2017) [9], who evaluated the nutritional properties of peels of some selected mango varieties. Mango peels are significantly different from each other in their protein content with values of 1.93%, 2.14% & 2.48% for Paparanda, Julie & Peter varieties respectively. Ajila *et al.* (2007) [1] also reported that the protein content in the peels of two Indian mango varieties were 2.05 and 2.16 respectively.

Fat content of tropical fruits are very low (Mudau, 2013). The fat content in sun dried samples are 0.21, 0.26, 0.61, 0.37 & 0.44 and 0.29, 0.33, 0.41, 0.38 & 0.24 respectively in hot air oven dried samples. Jaafar *et al*., (2009) [7] who stated the proximate analysis of stem & flesh of dragon fruit and stated that the fat content of flesh of dragon fruit is 0.21 – 0.61 g. Onuh *et al*., (2017) [9] who evaluated the nutritional properties of the peels of Paparanda, Julie & Peter. The fat percentage was 5.85% for Julie, 6.52% for Peter and 6.18% for Paparanda. The peels showed high amounts of fat. Whereas in the present study the fat was estimated in stage-II byproduct that is fibrous waste.

The mean carbohydrate content in sun dried sample is 81.95±1.025 g/100gm and 79.49±0.956 g/100gm in hot air oven dried sample which clearly indicates that mango fibrous byproduct is rich in Carbohydrates. Onuh *et al*., (2017) [9] reported that carbohydrate content in peel Paparanda, Julie and Peter was 68.83 ± 0.41, 68.69 ± 0.18 and 64.83 ± 0.35 respectively. The results exhibited significant ($p<0.05$) difference in carbohydrate content between sundried sample and hot air oven dried sample. Sun dried sample showed significantly ($p<0.05$) higher values of carbohydrate levels as compare to hot air oven dried sample.

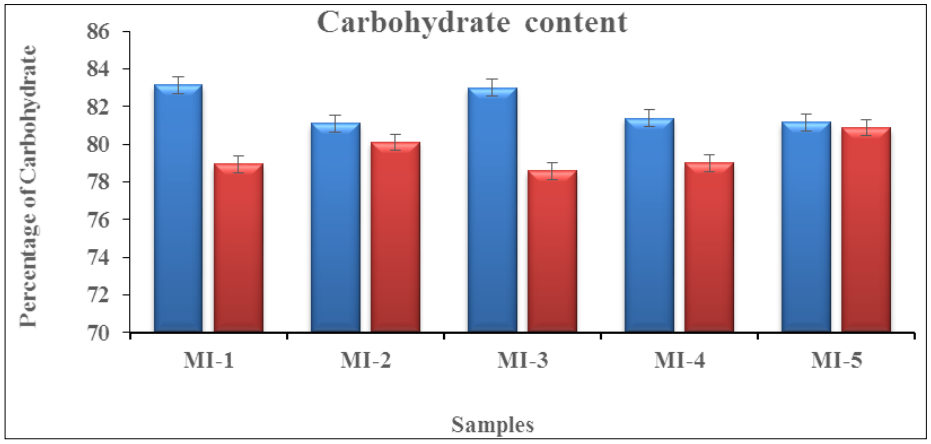

Fig 2: Carbohydrate levels in mango byproduct

4. Conclusion

Based on the above investigations, it could be concluded that the mango fibrous byproduct of stage-II from mango pulp processing contain various valuable components. The effective utilization of byproduct is most challenging topic of research. The utilization of whole byproducts or extraction of valuable components from the byproducts in the area of interest of the current research. Hence the present study was undertaken to analyze the valuable components in the mango stage-II byproduct. The study shows that the byproduct contains valuable components like fibre, carbohydrates and also contains optimum levels of macro and micro nutrients.

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