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The potence of mango peel to eradicate micronutrient deficiency

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ABSTRACT

"Hidden hunger" is the cry of the day, which is nothing but micronutrient deficiencies. More than 70% of preschool children consume less than 50% RDA of iron, Vitamin A and riboflavin. Therefore the goal should be to ensure a balanced diet adequate in macro and micronutrients. This could be accomplished only by fortification with the bioactive components. On the contrary conversion of fruit waste into a fortifying agent is less costly. This definitely will pave way for more intakes of bioactive compounds. The food industry produces large volumes of wastes, both solids and liquids, resulting from the production, preparation and consumption of food. Mango is considered to be a fruit with tremendous potential for future. The waste materials such as peels, seeds and stones produced by the fruit processing industry can be successfully used as a source of phytochemicals and antioxidants. Recently, mango peels have attracted considerable attention in the scientific community due to their high content of valuable compounds, such as phytochemicals, polyphenols, carotenoids, enzymes, vitamin E and vitamin C, which have predominant functional and antioxidant properties and also a rich source of dietary fibre, cellulose, hemicellulose, lipids, protein, enzymes and pectin.

Key words: Mango peel, micronutrient deficiency, fortification, antioxidant, dietary fibre, fruit waste.

Nutrition is the key in judging national development. About 50 per cent of children under five years of age are under weight and stunted and over 30 per cent of adults are undernourished in Indian scenario. "Hidden hunger" is the cry of the day, which is nothing but micronutrient deficiencies. The consequences of micronutrient deficiency are productivity losses (i.e.,) 10 per cent of lifetime earnings for individuals and 2 - 3 per cent of GDP to the nation. Cost for treating is 27 times more than prevention. The current mindset of looking at food security only in terms of energy security has to change. Pumping cereals alone to quench hunger will not ensure nutrition and health. More than 70 per cent of preschool children consume less than 50 per cent RDA of iron, Vitamin A and riboflavin. Moreover, repeated diet surveys done by the National Nutrition Monitoring Bureau (NNMB) (National Institute of Nutrition, ICMR) in 9 states of India and some other surveys, indicate, that Cereal-pulse based Indian diets are qualitatively deficient in micronutrients particularly iron, calcium, vitamin A, riboflavin and folic acid, due to low intake of income-elastic protective foods such as pulses, vegetables particularly green leafy vegetables (GLV), fruits and foods of animal origin. Therefore the goal should be to ensure a balanced diet adequate in macro and micronutrients. In order to address the above issue, an intensive research on Food to food fortification or enrichment is required. This could be accomplished only by fortification with the bioactive components.

Need for Conversion of fruit waste as fortifying agent

So far fruit wastes had been used for the extraction of pectin, enzymes, vinegar, fibre, animal feed, substrate for single cell protein, methane production and citric acid production only. Not much work has been done to extract the valuable components from the fruit wastes and conversion into a micronutrient fortifying agent, requires intensive research. Food fortificants are mostly synthetic supplements and makes the fortification process costlier. On the contrary conversion of fruit waste into a fortifying agent is less costly. This definitely will pave way for more intakes of bioactive compounds and in spite of this the utilization of by-products is, limited due to the poor understanding of their nutritional and economic value. The food industry produces large volumes of wastes, both solids and liquids, resulting from the production, preparation, and consumption of food. Depending on plant species, variety and tissue, high levels of health protecting antioxidants, such as vitamin C and E, phenolic flavonoids, carotenoids such as lycopene and dietary fibre can be found in fruit wastes. The waste materials such as peels, seeds and stones produced by the fruit processing industry can be successfully used as a source of phytochemicals and antioxidants. Therefore conversion of fruit waste into a potential micro nutrient fortifying agent is the need of the hour.

Wastes from food industry

Approximately 1.81, 6.53, 32.0 and 15.0 million tonnes of fruit wastes are generated in India, the Philippines, China and the United States of America, respectively (M. Wadhwa and M. P. S. Bakshi, 2013). A large proportion of these wastes are dumped in landfills or rivers, causing environmental hazards. Such unconventional resources can act as an excellent source of nutrients. Alternatives to such disposal methods could be recycling through livestock as feed resources and/or further processing to extract or develop value-added products (M. Wadhwa and M. P. S. Bakshi, 2013). Processing of fruits 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 (eg mango 30-50%, banana 20%, pineapple 40-50% and orange 30-50%) (P.Fellows and S.Azam Ali, 2003).

Mango (*Mangifera indica L.*) is the king among tropical fruits and has its origin in India. Approximately a thousand different types of mango fruits are produced in the country and it is greatly relished for its succulence, exotic flavour and delicious taste in most countries of the world (Solís-Fuentes & Durán-de-Bazúa, 2011). According to Muchiri, Mahungu and Gituanja (2012), mango fruit occupies the 2nd position as a tropical crop, behind only bananas in terms of production and acreage used. It has been well documented that mango fruits are an important source of micronutrients, vitamins and other phytochemicals. Moreover, mango fruits provide energy, dietary fibre, carbohydrates, proteins, fats and phenolic compounds (Tharanathan, Yashoda & Prabha, 2006), which are vital to normal human growth, development and health. Fortunately, mango is one of the few fruits which can be utilized in all stages of maturity and each part of a mango tree, such as its leaves, flowers, bark, fruit, pulp, peel and seeds contain essential nutrients that can be well utilized (Ravani *et al.,* 2013).The mango fruit is used as a dessert, as a table fruit between meals and is also processed for preparing a host of products. Established processed products include pulp, juice, squash, nectar, pickles, chutney, preserve, jam, canned slices, dried powder - and many other products. This conventional type of mango products have been developed to a considerable level and a significant demand has been built up by the processing industry, both for domestic and export market.

Waste from Mango Processing Industry

Mango is considered to be a fruit with tremendous potential for future. Worldwide production of mango is 38.95 million tones. Annual production of mango in India is 15.19 million tonnes (www.fao.org). Several million tons of mango wastes are produced annually from factories. Because mango is a seasonal fruit, about 20% of fruits are processed which have worldwide popularity (Ravani et al., 2013). Processed mango products are among the major goods exported, hence, several tons of mango peel wastes are produced annually from factories (Ashoush *et al.,* 2011). Depending on the cultivars and products made, its industrial by-products, namely peels and seeds, represent 35–60% of the total weight of the fruit (Jahurul *et al.*, 2015). The antioxidant compounds from waste products of the food industry could be used for protecting the oxidative damage in living systems by scavenging oxygen free radicals. These compounds can also be used for increasing the stability of foods by preventing lipid per oxidation (Lim *et al.*, 2006).

Health benefits of Mango Peel

Recently, mango peels have attracted considerable attention in the scientific community due to their high content of valuable compounds, such as phytochemicals, polyphenols, carotenoids, enzymes, vitamin E and vitamin C, which have predominant functional and antioxidant properties (Ajila et al., 2007). Moreover Sogi *et al.* (2013) has also reported that mango peels are also a rich source of dietary fibre, cellulose, hemicellulose, lipids, protein, enzymes and pectin. Mango peel is a good source of carotenes. Practical aspects of extraction and production of sufficient amounts of bio active components otherwise the nutraceutical components from most of these sources remain to be elucidated. The growing interest in the substitution of costlier synthetic food fortificants to address hidden hunger, by natural ones has fostered research on fruit waste and for identifying new fortificants, namely carotenoids, vitamin E, vitamin C, dietary fibre derived from fruit waste.

Peels, pomace and seeds are a rich source of polyphenols and bio-active compounds, which can be extracted and utilized for food and pharmaceutical applications. Their concentration in these fractions is more than twice that in edible tissue. These exhibit anti-cancer, anti-microbial (pathogens), anti-oxidative and immune-stimulating effects in vertebrates and reduce the incidence of cardiovascular diseases (Martinez *et al*., 2012).

These valuable compounds are beneficial for human health. Mango peels can be utilized for the production of valuable ingredients (i.e., dietary fibre and polyphenols) for various food applications, as has been reported by many researchers (Aziz *et al.*, 2012).

In recent decades people become conscious about their diet and health. Nutritionist suggest to take food that has low fat content and provide less calories as well as rich in antioxidant and dietary fiber contents (Ajila *et al*., 2008).

Antioxidants and dietary fiber are gaining popularity because they contribute significantly lowering the cholesterol and prevent the cardiovascular diseases and constipation (Schieber *et al*., 2001). It has been reported that synthetic antioxidants exhibit toxicity and carcinogenecity properties. Thus, the demand for antioxidant substances naturally found in fruits and vegetables has increased since the use of those substances in products has been considered to be more healthy and can be more effective in retarding food oxidation (Bub *et al*., 2003).

The most bioactive compounds, such as phenolic compounds, carotenoids, vitamin C and dietary fibre, present in mango peels contribute to lowering the risk of cancer, Alzheimer's disease, cataracts and Parkinson's disease, among others (Ayala-Zavala *et al.*, 2011). The antioxidant and radical scavenging activities of these bioactive compounds have been shown to delay or inhibit the oxidation of DNA, proteins and lipids (Ayala-Zavala *et al.*, 2011).

Average Composition of mango Peel (%)		
Composition	Fresh Mango Peel	Dried Mango Peel
Moisture	70	10
Total Solids	25	70
Reducing Sugars	7	30
Non reducing sugars	5	4
Protein	3.5	4
Cellulose and lignin	25	23

(Ref: Reddy *et al.*, 2011)

The total dietary fibre content ranged from 40.6% to 72.5%. The results showed that galactose, glucose and arabinose are the major neutral sugars in insoluble and soluble dietary fibres. The mango peel, which is rich in dietary fibre can be used in functional foods, as reported by Ajila and Rao (2013).

CONCLUSION

Waste utilization from food processing industries is highly indispensable and challenging task all around the globe. Generation of this waste is inevitable because every time we have to produce the finished product of the same consistency without taking into consideration the amount of waste produced. Waste by definition means anything unused or not used to full advantage. When fruits and vegetables are consumed for household purposes, waste might mean any rotten or over/under-ripe fruit or vegetable. While in fruits or vegetables processing sector, the composition of waste is different, i.e., it will contain less of over or under-ripe fruit or vegetable, rotten organic matter but more of cellulosic waste like peels and seeds. The use of this composite mass of cellulosic or fibrous waste with some carbohydrates is a mine of phytochemicals. Actual figures on the quantity of mango waste generated commercially are not readily available. Disposal of wastes from industries has been a problem due to high transportation costs and limited availability of landfills, as these by-products carry no commercial value, they are often disposed unscrupulously. Improper disposal of mango peel waste may appreciably increase the environmental pollution due to its rapid decay, eventually becoming a source of insect multiplication. Processing of mango by-products reduces waste disposal problem, adds value to the product for food and other industrial use, and the isolated active component can be used in food fortification. Therefore, the utilization of mango by-products may be an economical way to reduce the problem of waste disposal from mango production. From above discussion it can be concluded that every year fruit processing industry is wasting a considerable amount of bio-active material that can play a vital role to address the micronutrient deficiency in India.

REFERENCES

Ajila, C. M., Naidu, K. A., Bhat, S. G., and Prasada Rao, U. J. S. 2007. Bioactive compounds and antioxidant potential of mango peel extract. *Food Chemistry,* 105: 982–988.

Ajila, C. M., Leelavathi, K., and Prasada Rao, U. J. S. 2008. Improvement of dietary fiber content and antioxidant properties in soft dough biscuits with the incorporation of mango peel powder. *Journal of Cereal Science*, 48(2), 319–326.

Ajila, C. M., and Rao, U. J. S. 2013. Mango peel dietary fibre: Composition and associated bound phenolics. *Journal of Functional Foods*.http://dx.doi.org/10.1016/j.jff.2012.11.017.

Ashoush and Gadallah M.G.E. 2011. Utilization of Mango Peels and Seed Kernels Powders as Sourcesof Phytochemicals in Biscuit. *World Journal of Dairy & Food Sciences*, 6 (1): 35-42, 2011

Ayala-Zavala, J. F., Vega-Vega, V., Rosas-Domínguez, C., Palafox-Carlos, H., Villa-Rodriguez, J. A., Siddiqui, M. W., et al. 2011. Agro-industrial potential of exotic fruit byproducts as a source of food additives. *Food Research International*, 44, 1866–1874.

Aziz, N. A. A., Wong, L. M., Bhat, R., & Cheng, L. H. 2012. Evaluation of processed green and ripe mango peel and pulp flours (Mangifera indica var Chokanan) in term of chemical composition, antioxidant compounds and functional properties. *Journal of the Science of Food & Agriculture*, 92, 557–563.

Bub, A., Walzl, B., Blockhaus, M., Briviba, K., Lieqibel, U., Muller, H., Pool-Zobel, B. L. and Rechkemmer, G. 2003. Fruit juice consumption modulates antioxidative status, immune status and DNA damage. *The Journal of Nutritional Biochemistry,* 14: 90-98.

Jahurul, M. H. A., Zaidul, I. S. M., Norulaini, N. A. N., Sahena, F., Rahman, M. M., & Mohd Omar, A. K. 2015. Optimization of supercritical carbon dioxide extraction parameters of cocoa butter analogy fat from mango seed kernel oil using response surface methodology. *Journal of Food Science and Technology*, 52, 319–326.

Lim, Y. Y., Lim, T. T., and Tee, J. J. 2006. Antioxidant properties of guava fruit: comparison with some local fruits. *Sunway Academic Journal*, 3: 9-20.

Muchiri, D. R., Mahungu, S. M., & Gituanja, S. N. 2012. Studies on Mango (Mangifera indica, L.) kernel fat of some Kenyan varieties in Meru. *Journal of the American Oil Chemist's Society*, 89, 1567–1575.

Ravani and D C Joshi. 2013. Mango and it's by product utilization–a review. *Trends in Post Harvest Technology*, www.Jakraya.com/journal/tpht.

Reddy, L.V., Reddy, O.V.S. & Wee, Y.J. 2011. Production of ethanol from mango (*Mangifera indica* L.) peel by *Saccharomyces cerevisiae* CFTRI101. *Afr. J. Biotechnol*. 10: 4183-4189.

Schieber, A., Stintzing, F. C., & Carle, R. 2001. By-products of plant food processing as a source of functional compounds-recent developments. *Trends in Food Science & Technology*, 12, 401–413.

Sogi, D. S., Siddiq, M., Greiby, I., & Dolan, K. D. 2013. Total phenolics, antioxidant activity, and functional properties of 'Tommy Atkins' mango peel and kernel as affected by drying methods. *Food Chemistry*, 141, 2649–2655.

Solís-Fuentes, J. A., & Durán-de-Bazúa, M. C. 2011. Mango (Mangifera indica L.) seed and its fats.

Nuts and Seeds in health and disease prevention, 741–748
Tharanathan, R. N., Yashoda, H. M., & Prabha, T. N. 2006. Mango (Mangifera indica L.), ‘‘The king of fruits’’ – A review. *Food Reviews International*, 22, 95–123.
Wadhwa, M. ; Bakshi, M. P. S. ; Makkar, H. P. S., 2013. Utilization of fruit and vegetable wastes as livestock feed and as substrates for generation of other value-added products. http://www.fao.org/docrep/018/i3273e/i3273e.pdf
www.fao.org