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RESEARCH ARTICLE

UTILIZATION OF MANGO AND ITS BY-PRODUCTS BY DIFFERENT PROCESSING METHODS

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ABSTRACT

The utilization of mango by-product is a good source of potentially valuable for food, pharmaceutical and nutraceutical industries. The large amount of waste disposed by the food industries cause serious environmental problem. Food preservation and processing become vital in order to utilized and maintain its organoleptic properties like taste, flavor, and appearance. It is a great source to utilize the mango by-products by the processing of different product formation as mango breakfast cereal, mango dried chutney and mango shrikhand. The aim of this present review is to summarize the current information about the utilization of mango by-Products to reduce the disposal problem and enhance the organoleptic properties which can be used as food fortification.

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INTRODUCTION

Mango (*Mangiferaindica L),* considered as "The king offruits" it is the most popular old and ancient fruit in the world. Pleasurable anticipation due to their pleasant taste and aroma and high nutritional value. It is the member of cashew family (Anacardiaceae) and one of the most important and widely cultivated fruit of the tropical world. Mango fruit are greater source of micronutrient, vitamins and other phytochemical. Moreover it is a nutritionally important fruit being a good source of vitamin A, B and C and minerals. It is the second most traded tropical fruit in the world and fifth in total production (FAOSTAD, 2015). The world production of mango is estimated at 42 million tons per year; India is the largest producer of mango with 1,525,000 tons per year (FAOSTAD, 2015). Mango is a fruit that is useful at the stage of flowering till the stage of maturity. The fruit are oval or kidney shaped with Smooth, leathery skin and the colour ranges from light or dark green to clear yellow when ripe. The fully ripened fruits are used for table purpose and the unripened fruits are used for making pickles. The fruit pulp is also used as a dessert or processed into juices, jams and other products. While the seeds are discarded which often results in environmental pollution. Despite the fact that mango seed kernel contain 6% protein, 11% fat, 77% carbohydrate, 2% crude fiber and 2% ash .

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While mango peel are consider approximately 7-24% of the total weight mango fruit. Moreover (Sogi *et al.,* 2013) reported mango peels as a rich source of dietary fiber, cellulose, hemicellulose, lipids, protein enzyme and pectin. It is very good for human health. The research has been done on the processing technology of the mango and mango by-product to improve the quality and utilization of mango as an important food resource. Mango are processed at two stages as raw and ripe one. Green fruit is used to make chutney, pickles, green mango powder and dehydrate product. While ripe product is used to make mango pulp, beverages, puree, slices, jam, juices, nectar and various dried products.

Green mango products

Mango is one of the few fruit which is utilized in all stages of its maturity from unripe stage to ripe stage. The green mango (young immature unripe stage) should be freshly picked from the tree. Raw mango is the star fruit of spring. Its tangy flavour compliments the weather beautifully. Raw mango are sour and green in colour its smells like pungent. Several other products are made from green mango fruit.

Mango pickle

Mango pickle is a spicy and tangy condiment. Mango pickle are classified as salt pickle or oil pickle or sweet pickle based on the type of preservation used. Raw mango cut into pieces, remove the stone than dried in the sun for a couple of days. Added some flavour, salt, mustard oil, and stew powder.

Mixed all the ingredients and kept in a major pot in the sun for a few days.

Mango powder

Aamchur also referred to as mango powder, is a fruity spice powder made from dried unripe green mango and is used as citrusy. Mango powder is ground from tart, unripe mangos which are sliced and sun-dried before grinding. It is not an actual "spice" but it can be used as citrusy in food as lemon juice etc. it is used in many dishes, like curries, chutney.

Mango chutney

A piquant relish or sauce of Indian origin, typically combining sweet and sour ingredients, and also vinegar with sugar and spices prepared from sliced or grated mangoes.

Ripe mango products

Ripe mango are luscious and sweetened, with a yellow- orange or red skin. They are ready to eat when it feels soft and give a gentle squeeze.

Mango pulp

Mango pulp is prepared from selected varieties of fresh mango fruit. Fully matured mangoes are harvested, quickly transported to the fruit processing plant. The refined pulp is also packed in cans, hermetically sealed and restored frozen pulp is pasteurized and deep frozen in plant freezers. No preservation is used in the caned mango pulp. However, when the pulp is filled in polyethylene jars for beverage and jam preparation, potassium metabisulphite used as preservative (Kumbhar, 1992).

Mango beverages

In mango beverages there are three important beverages prepared on a commercial scale- mango juice, nectar as well as squash. Mango juice is prepared by adding equal quantity of water and adjusting the total soluble solid and acid. Mango nectar contain 20% pulp with sugar and acidity. These beverages are packed in cans (Mahadeviah *et al.,* 1969). Mango squash contain 25% juice, 45% TSS and 1.2 to 1.5% acidity and is preserved with preservative in a glass bottle (Mathur and Purnanandam, 1976; Kumbhar, 1992).

Mango jam

To prepare mango jam, pulp from dehydrated mango slices was heated with an equal quantity of sugar to 65-68oB and citric acid was added at the end to get 0.6-0.7% acidity in the final product score for colour and flavour (Mallik, 1976; Mathur and Purnanandam, 1976; Sagar and Khurdiya, 1998). Kanekar (1992) had studied sugar and acid tolerant microorganisms causing spoilage in mango jam.

Mango By-Product Utilization

After consumption or industrial processing of the fruits, considerable amounts of mango seeds and pulp are discarded as waste (Puravankara *et al.,* 2000); Therefore, the utilization of mango by-products especially mango seed, peel may be an economical way to reduce the problem of waste disposal from mango production. The utilization technologies for different categories of mango by-products are- mango ready to eat breakfast cereal, mango dried chutney.

Mango kernel is a good source of starch and fat. Mango seed kernels have a low content of protein but they contain the most of the essential amino acids. Mango kernel is a good source of starch and fat. A preliminary study showed that the seed represents from 20% to 60% of the whole fruit weight, depending on the mango variety and the kernel inside the seed, which represents from 45% to 75% of the whole seed (Maisuthisakul and Gordon, 2009).

Mango peel, generally termed as "total waste" is the second most important waste generated in the processing factories. During processing of mango, peel a major by- product, contributes about 15-20% of the fruit (Beerh and Raghuramaiah, 1976). Peel has been found to be a good source of phyto-chemicals, such as polyphenols, carotenoids, vitamin E, dietary fibre and vitamin C and it also exhibited good antioxidant properties (Ajila *et al.,* 2007; Kim *et al.,* 2010).

Organoleptic properties and Sensory evaluation is a scientific discipline that analyses and measures human responses to the composition of food and drink, e.g. appearance, touch, odour, texture, temperature and taste. In schools it provides an ideal opportunity for students to evaluate and give feedback on their dishes, test products and experimental designs.

Sensory evaluation can be used to:

- Compare similarities/differences in a range of dishes/products;
- Evaluate a range of existing dishes/food products;
- Analyse food samples for improvements;
- Gauge responses to a dish/product, e.g. acceptable v unacceptable;

Explore specific characteristics of an ingredient or dish/food product

MATERIALS AND METHODS

Processing and packaging method used in product formation

Material used in processing of mango by-product: The required material for the processing are mango seed, mango peel, mango pulp, chia seed, quinoa seeds, mango powder, jaggery, coconut powder, mint.

Processing of mango by-products for the processing of mango by-products fresh mango selected from the market, which were further divided into two processes. Collection of mango by-product and the product formation. Select the fresh mango remove the peel, pulp, and seed were dried in order to reduce the initial moisture content in dehydrator giving the sun dry heat to reduce the moisture after drying the peel pulp and seed were grinded. Dried mango peel, pulp, and seed powder is ready. Product formation further done by two product formation as mango breakfast cereal and mango dried chutney as well as mango shrikhand.

Product I Take all the ingredient (mango seed powder, mango peel powder, mango pulp powder, chia seed powder, quinoa seed powder and ragi flour) roast all the dry ingredient except mango pulp powder after roasting properly all the ingredient grind in a mixture individually when the grinding process is done the ingredients are mixed together in a bowl and added the mango pulp powder the mango breakfast cereal is ready by adding all the ingredients added in an appropriate amount.

Product II Take all the ingredient (mango seed powder, mango peel powder. Mango pulp powder, coconut powder, jaggary powder and mint powder) roast all the dry ingredient except mango pulp powder after roasting properly all the ingredient grind in a mixture individually when the grinding process is done the ingredients are mixed together in a bowl and added the mango pulp powder also added some species as according to the taste mango dried chutney is ready to serve.

Product III Take a large bowl pour the hung curd with dried mango pulp and mango seed powder in little amount than add fresh mango pulp and sugar to taste after that mixed with blender until all the ingredients are mixed very well. At last refrigerate up to 30-40 minutes. Serve in a bowl.

Material used in packaging plane polythin and aluminum wrapper

Packaging of mango by-products Take 20 polythene and 20 aluminum wrapper.Firstly packed in plane polythene or in aluminum wrapper and sealed it with the help of sealing machine. Packed mango breakfast cereal and stored in room temperature.

Organoleptic properties evaluation of the mango by-products processing of mango by-products by different method mentioned the code upon the sample organoleptic properties were evaluated by the panelist then score card were filled by panelists. The best processing method of mango by-products was evaluated by the given score of panelists. Calculate the given score.

RESULTS AND DISCUSSION

Sensory evaluation of packed and processed mango by-products by experts panel of members on hedonic scale and marking was done on the six parameters-

- Body and texture
- Colour
- Appearance
- Flavour
- Taste
- Overall acceptability

Treatment

Table 1. Individual marked for body and texture

MEMBERS	T1	T2	T3
Member 1	9	8	8
Member 2	7	9	6
Member 3	8	7	7
Member 4	7	7	7
Member 5	9	7	6
Total	40	38	34

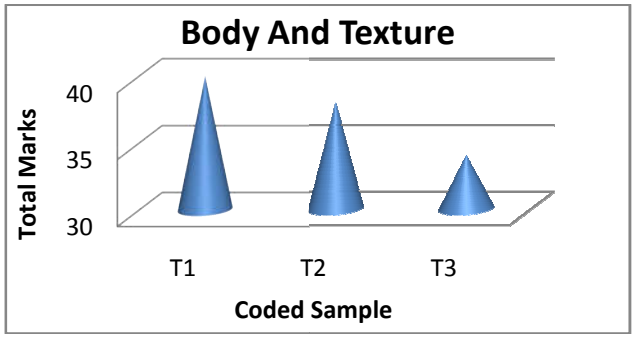

Fig. 1. Graphical representation of texture

Above graph shows that T1 is most acceptable sample T1 in term of texture among the sensory panellist members and it get highest scoring. Then after sample T2 and sample T3 respectively.

Table 2. Individual marked for colour

MEMBER	T1	T2	T3
Member 1	8	9	9
Member 2	7	9	9
Member 3	7	7	7
Member 4	6	7	6
Member 5	5	6	6
Total	33	38	44

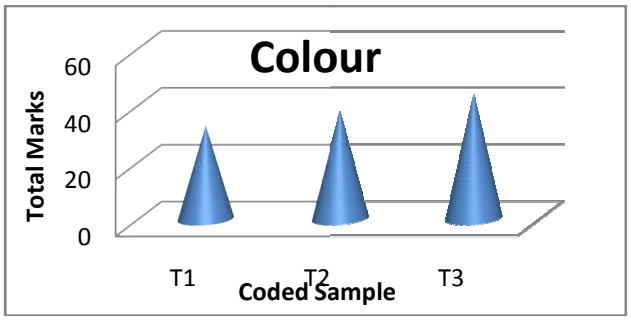

Fig. 2. Graphical representation of colour

Above graph shows that T3 is most acceptable sample T3 in term of colour among the sensory panellist members and it get highest scoring. Then after sample T2 and sample T1 respectively.

Table 3. Individual marked for appearance

MEMBER	T1	T2	T3
Member 1	8	9	9
Member 2	7	9	9
Member 3	8	7	8
Member 4	7	7	7
Member 5	6	7	8
Total	36	39	41

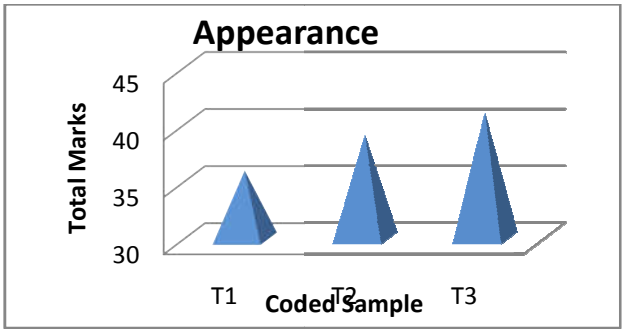

Fig. 3.Graphical representation of appearance

From the graph, it shows that T3 is most acceptable sample T3 in term of appearance among the sensory panellist members and it get highest scoring. Then after sample T2 and sample T1 respectively.

Table 4. individual marked for flavor

MEMBER	T1	T2	T3
Member 1	9	9	8
Member 2	7	9	8
Member 3	8	8	7
Member 4	7	7	6
Member 5	6	8	6
Total	37	41	35

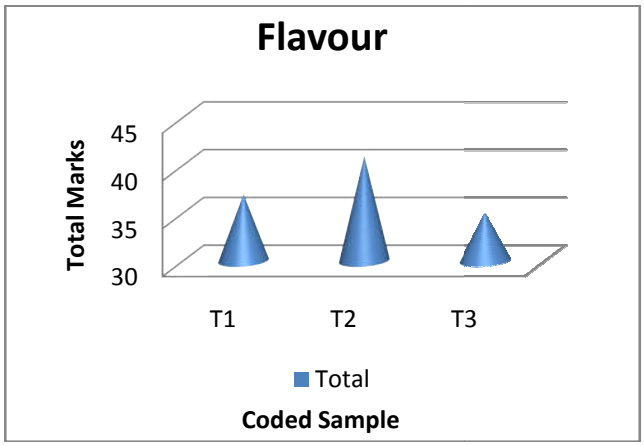

Fig. 4. Graphical representation of flavor

From the graph, it shows that T2 is most acceptable sample T2 in term of flavour among the sensory panellist members and it get highest scoring. Then after sample T1 and sample T3 respectively.

Table 5. Individual marked for taste

MEMBER	T1	T2	T3
Member 1	9	9	8
Member 2	8	9	8
Member 3	8	8	8
Member 4	6	9	9
Member 5	6	7	9
Total	37	42	42

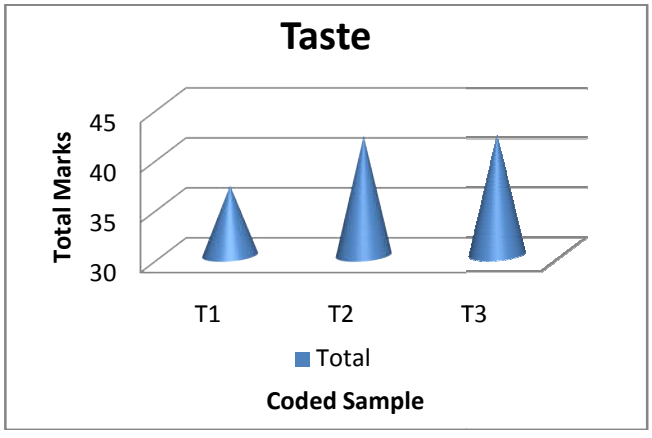

Fig. 5. Graphical representation of taste

From this graph, it shows that sample T2 and T3 is most acceptable in term of taste among the sensory panellist members and both samples are get same scoring. Then after sample T1 respectively.

Overall acceptability

Table 6. Individual marked for overall acceptability

MEMBER	T1	T2	T3
Member 1	9	9	8
Member 2	8	9	8
Member 3	8	7	8
Member 4	7	9	7
Member 5	9	9	7
Total	41	43	38

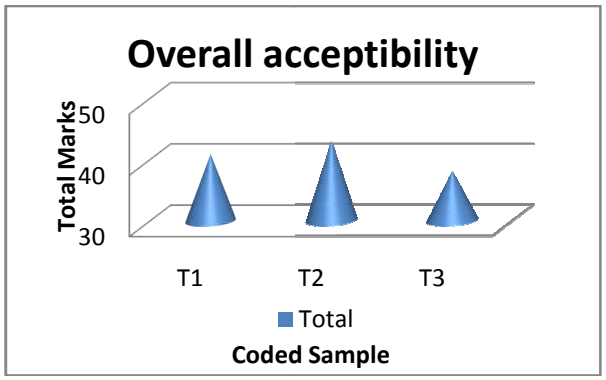

Fig. 6. Graphical representation of overall acceptability

From the graph, it shows that overall acceptability of sample T2 was most among the sensory panellist members and it gets highest scoring, then after sample T1 and T3 respectively.

Overall calculation

Overall calculation are done to know most acceptability of the product in all terms of quality by sensory evaluation scoring given by the panellist members, in this all scoring of texture, colour, appearance, flavour and taste are calculated in the table, by this we get do statistical analysis and obtained standard deviation, average and other calculations.

Table 7. Overall calculation

Perameters	T1	T2	T3
1	40	38	34
2	33	38	44
3	36	39	41
4	37	41	35
5	37	42	42
6	41	43	38
Total	224	241	234
Average	37.33	40.16	39.0
Standard deviation	2.87	2.13	4

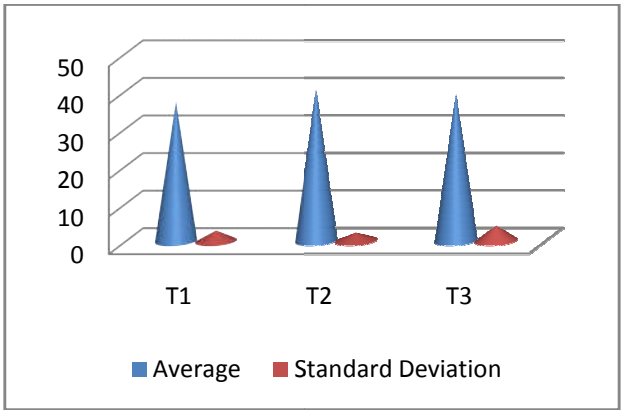

Fig. 7.

Overall calculation

- In this table of overall calculation we got the average of T1, T2 and T3 are 37.33, 40.16 and 39.0 respectively.
- Standard deviation are 2.87, 2.13 and 4 respectively.
- Sample T2 with highest average and lowest standard deviation is most acceptable statistically, hence sample T2 is most acceptable among all.

Summary and conclusion

The utilization of mango by- products enhances due to the quality of mango by products that are rich source of many utilizable component. The product formation by using the mango by-products contain many health enhancement substances for a balance diet. These product optimizes the availability of energy, protein, carbohydrate and fat. These food are ready to eat which is very easily too consumed by others. For the insurance product quality, organoleptic indicator is good to determine the quality and freshness of product. The organoleptic evaluation of the mango by-product was done by using nine point hedonic scales by panels of 5 members. The scoring for each of the product was done according to various parameters i.e. texture, taste, flavor, colour and appearance and overall acceptability.

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