

RESEARCH ARTICLE

Preparation of Fruit Leather and Fortification with *Moringa oleifera*

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ABSTRACT:

Fruits play a major role in human diet. They are indispensable sources of vitamins, minerals and crude fibers. Fruit leathers are tasty and convenient, on the go snacks with high level of acceptability. They are food products consisting of fruit pulp, sugars, pectin and preservatives which are dehydrated at a temperature of 50°C. Here, *Malus domestica* (Apples) and *Ficus carica* (figs) were chosen as the base ingredients of the leather, in ratio of 25:75, 50:50, 75:25 were considered out of which the 75:25 ratio was found to have optimum organoleptic acceptability. *Moringa oleifera*, a native plant of India, is often considered as a modern day super food because of the plethora of nutrients present, an excellent source of calcium, iron, vitamins, minerals and antioxidants. Due to these benefits, *Moringa oleifera* has been chosen as the fortifying agent. Different concentrations of this fortificant-1g, 2.5g, 5g and 7.5g were taken and 2.5g were found to be most favorable. By incorporating this fortificant into the fruit leathers, it improved the nutritional value of the product. The chemical, physical and microbial parametric analysis along with storage tests were carried out and the results were recorded. The fortified fruit leather was found to be rich in calcium, which is a highly essential mineral in maintaining bone health.

KEYWORDS: Fruit leathers, *Malus domestica*, *Ficus carica*, Fortification, *Moringa oleifera*.

INTRODUCTION:

Fruits have been used by humans as food and medicine since prehistoric times. Although, fruits are highly nutritious and widely available all over the world. Fruits are rich in a variety of nutrients, vitamins and minerals, consumption of which reduces nutritional deficiency disorders. Fruits have very short harvest season, so preparation of fruit leathers/bars from fruits is an effective method to preserve and future use without major nutritional changes. Fruit leathers also are confectionary dehydrated food snacks or desserts, generally prepared by mixing fruit puree with additives such as sugar, pectin, preservatives, color, and dehydrating them under suitable conditions. It is light weight and easy to carry, convenient snack which can be easily stored and packed.

All fresh fruits are highly susceptible to high degree of damage due to a variety of factors and developing a fruit leather is an effective method of preservation of its nutrients¹. They are high calorie food. The origin of fruit leathers may go back to olden period and fruit leathers allow leftover ripe fruits to be preserved². These leathers are firm in texture but highly malleable in nature. Fortification is the process of value addition in food, wherein particular nutrients are supplemented into the diet in order to meet the nutritional requirements and to prevent nutritional deficiency diseases or illness. Fortifying agents are compounds that are added to food carriers in order to supplement the carrier with one or more necessary target nutrients. In this study, the dried leaves of *Moringa oleifera* are chosen as the fortificant. *Moringa oleifera* is considered as the modern day super food because of its plethora of valuable nutrients. It is universally known as the miracle plant or the tree of life. Moringa trees have been used to treat malnutrition among children and nursing mothers³. Moringa leaves have been proposed as an iron-rich, calcium rich food source to medication in iron and calcium deficiencies. In addition to that *Moringa oleifera* was reported to have higher antioxidant content⁴. *Moringa oleifera* tree is a plant rich in a number of nutrients such as proteins, fiber and minerals that are essential for a healthy human diet⁵.

MATERIALS AND METHODS:

Fresh fruits namely *Malus domestica*, *Manilkarazapota*, *Musa paradisiaca*, *Ficus caricaa* and *Moringa oleifera* leaves obtained from the Parrys market, Chennai. The fruits were immediately processed into the fruit leather after purchasing. The *Moringa oleifera* powder is employed as an essential component to induce fortification. 25 grams of fresh and clean *Moringa oleifera* leaves were weighed and cleaned with water. The cleaned leaves were then spread over a plate and shade dried for a period of 48 hrs. The dried leaves are then powdered using a blender. The powder is then passed through a mesh filter to obtain uniformly sized particles. This powdered form is used as the fortificant.

Preparation fruit leather and Flavour profiling study:

Pulp was extracted from the peeled fruits with the help of blender. To the pulp Sugar, Skim Milk Powder (SMP)(3g), Citric acid (0.9g), Maltodextrin (1g) Pectin (1.5g) were added⁶ Flavor profiling was done to find out the most optimum acceptance level. This was carried out to finalize the fruits to be used in the production of fruit leather. Fruits in the following combination were used: *Ficuscarica/ Manilkarazapota* (A), *Ficuscarica/Malus domestica* (B), *Ficuscarica/Musa paradisiaca* (C) and *Ficuscarica/Malus domestica/Manilkarazapota/Musa paradisiaca* (D). Above chosen combination of fruits allowed to produce leather through Refrigeration (4° C), Microwave oven (800 Watt) and Hot air oven (50°C) (Fig.1) and analyzed to find the most optimum method in terms of time and temperature⁷. After profiling, the fruit flavour combination of *Ficuscarica* (25g) and *Malus domestica* (75g) are processed by Hot air oven at 50°C for 2 hours were chosen (Table1) for further fortification.



Fig. 1: Flowchart for preparation of fruit leather

Table 1: Variation in fruit puree

Fruit Pulp	Concentration		
	<i>Malus domestica</i>	25g	50g
<i>Ficuscarica</i>	75g	50g	25g

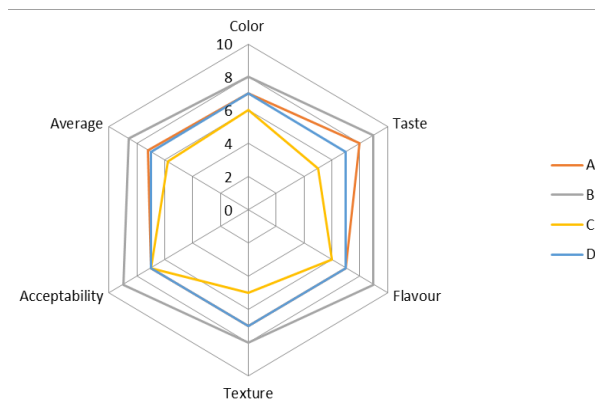


Fig. 2: Organoleptic evaluation of flavour profiling

Fortification of fruit leathers:

Attempts were made to develop and fortify the fruit leather for which different proportions of fruit pulp, sugar, skim milk powder (Table 2) and *Moringa oleifera* leaf powder were considered to optimize the composition of fruit leather. The mixture was poured into trays smeared with butter in a highly thin layer and dried at 50°C for 2 to 2 and a half hour in a hot air oven.

Table 2: Variation in concentration of sugar and skim milk powder

Component	Sample 1	Sample 2	Sample 3
Sugar	20g	15g	20g
Skim milk powder	3g	6g	6g

NOTE – 75: 25g of *Malus domestica* and *Ficuscarica* were chosen as standard.

Analysis fruit lather:

The resulting fruit leathers (before addition of fortificant and after addition of fortificant) were analysed for the following parameters, namely Physical analysis, Chemical and Nutritional analysis by standard analytical procedures^{8,9}. Organoleptic analysis, Microbial analysis and Stability testing¹⁰.

RESULTS AND DISCUSSION:

Various Sensory parameters like flavour, taste, colour, appearance and texture were analysed for optimization of fruit puree proportion, optimization of Sugar and Skim milk powder concentration and optimization of appropriate amount of *Moringa oleifera* (Fortifying agent) (Fig.2 and 3) and found to be 75g:25g, 20g, 6g and 2.5g respectively. Chemical analysis such as estimation of Moisture content (%), Acidity as Citric acid (g), Ash content (g) and Total soluble solids (% brix) were estimated and recorded as 14.2g, 2.4%, 1.6g and 10.2% respectively. Nutritional labelling of the sample for the parameters such as Energy, Carbohydrates, protein, Total Fat, calcium, potassium, sodium, phosphorous, dietary fibre and iron were done

for two samples namely, without *Moringa oleifera* and with the addition of *Moringa oleifera* and was found to increase. It was noted that there was a significant

increase in the calcium content from 146mg to 314mg (Table 3).



Fig. 3: Fruit leather (a) Without *Moringa oleifera* (b) With *Moringa oleifera*

Table 3: Chemical analysis of fruit leather before and after fortification

S. No	PARAMETERS	METHOD	UNITS	RESULTS	
				Without MO	With MO
1	Energy (By Calculation)	FAO Method	Kcal/100g	345	352
2	Carbohydrates (By difference)	CTL/SOP/FOOD/262 – 2014	g/100g	73.1	77.3
3	Total Fat	AOAC 20 th Edn.2016, 954.02	g/100g	4.4	3.1
4	Protein (Nx6.25)	AOAC 20 th Edn.2016, 986.25	g/100g	3.3	3.8
5	Dietary fibre	AOAC 20 th Edn.2016, 985.29	g/100g	3.1	2.15
6	Sodium as Na	AOAC 20 th Edn.2016, 969.23	mg/100g	138	107
7	Potassium as K		mg/100g	247	331
8	Calcium as Ca	IS 5949:1990 (RA.2003)	mg/100g	146	314
9	Iron as Fe	AOAC 20 th Edn.2016, 999.11	mg/100g	1.14	1.36
10	Phosphorous as P	AOAC 20 th Edn.2016, 995.11	mg/100g	20.4	19.6
11	Moisture	AOAC 20 th Edn.2016, 984.25	g/100g	17.8	14.2
12	Ash	AOAC 20 th Edn.2016, 925.51	g/100g	1.4	1.6
13	Acidity as Citric acid	FSSAI Manual (Fruits and Vegetables)	%	2.6	2.4
14	Total Soluble Solids		%	10.4	10.2

Sensory parameters such as like flavour, taste, colour, appearance and texture were analysed for the overall evaluation of the sample and found to be with medium to good acceptability levels with taste scoring the highest,8 (Fig. 4 and 5).

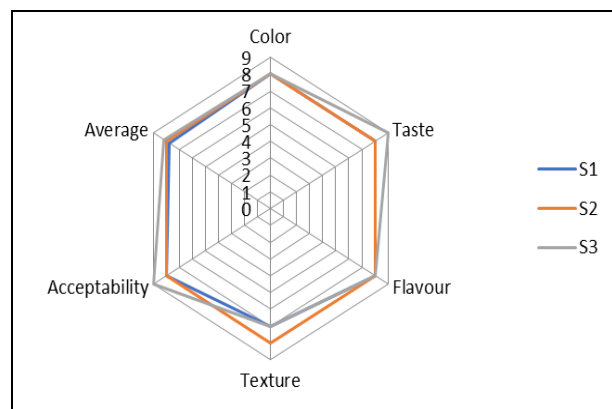


Fig. 4: Average of sensory evaluation scores for different proportions of fruit puree

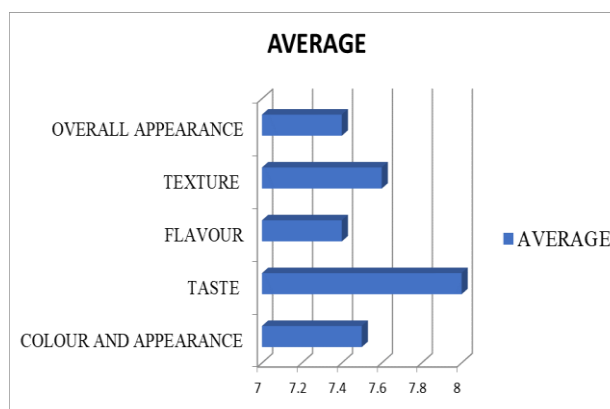


Fig. 5: Average sensory scores for fruit leathers

The stability of the fortified fruit leather was analyzed by placing the sample at room temperature as well as refrigerator temperature for 40 days and found that there are no color, taste and appearance changes. Microbial load analysis was performed for fruit leather fortified

with 2.5g of *Moringa oleifera* powder using plate count estimation periodically on 1st day, 10th day, 22nd day, 38th day¹¹. The colonies obtained were counted using colony counter and number of colonies (X10-3 cfu/g), it was observed that the colonies grown the sample was well within the safe limits with colonies in the range 0 colonies, 5 colonies, 12 colonies and 18 colonies respectively. However the growth of microbes in food depend upon the moisture¹².

CONCLUSION:

This study was performed to develop nutrition rich, mainly calcium fortified fruit leather by using *Moringa oleifera* as the fortificant. The developed product was subjected to various analyses. From the above observations obtained by performing the analyses, it can be concluded that *Moringa oleifera* fortified fruit leather was highly nutritious and can be a tasty and on the snack, which may used a supplement for providing the human body with sufficient amounts of calcium. This shows that the *Moringa oleifera* fortified fruit leather was highly stable and has a good shelf life.

CONFLICT OF INTEREST:

The authors declare no conflict of interest.

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