

Formulation of Micronutrient Rich (Iron, Vitamin C) Composite Powder Using Under-Exploited *Panicumsumatrense*, *Brassica oleraceae*, *Phyllanthusacidus* and Evaluation of its Acceptability in Common Recipes

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Abstract: Nature has provided us plant foods that are available in enormous seasonally and are not utilized to the extent they should be in spite of their higher nutritive value. *Panicumsumatrense* (Samai), *Brassica oleraceae* (Cauliflower leaves), *Phyllanthusacidus* (Star gooseberry) are such foods that are under-exploited. Hence the present study involves processing and utilization of these foods in recipes that are commonly consumed so as to enrich the nutrient proportion especially the micronutrients viz iron and vitamin C.

Keywords: *Panicumsumatrense*, *Brassica oleraceae*, *Phyllanthusacidus*, iron, vitamin C.

1. Introduction

Micronutrient deficiency disorder especially iron deficiency anaemia (IDA) is found to be common among pregnant women and preschool children owing to dietary deficiency of iron and vitamin C. Two billion people around the globe are deficient in micronutrients^[1].

India is a country with rich sources of various natural foods that are available in splendid seasonally which are under-utilized in spite of their higher nutritive value. *Panicumsumatrense* known as Samai in Vernacular language (Tamil) is minor millet consumed in the tribal community in India has conferred health benefits as a good source of energy, protein, iron, and dietary fibre^[2]. Cauliflower (*Brassica oleraceae* var. *Botrytis*) is grown extensively in India for its edible head portion and the leaves which are generally thrown has been found to be rich in iron and β -carotene^[3-5]. Star gooseberry (*Phyllanthusacidus*) one of the most popular fruit grown in the backyards of many homes with few studies^[6, 7] reporting for its nutrient richness and antioxidant properties are also found to be less utilized.

As an attempt to overcome micronutrient malnutrition especially iron deficiency anaemia (IDA), the study was involved in the processing and utilisation of under-utilised plant foods (viz samai, cauliflower leaves and star gooseberry) as concentrated source of micronutrients (Iron and Vitamin C) in common recipes and evaluation of its acceptability.

2. Methods

1) Processing of *Panicumsumatrense*, *Brassica oleraceae* and *Phyllanthusacidus*

Panicumsumatrense was purchased from local market and a known quantity (4 kg) of was washed, soaked overnight, ground with water and the fluid was extracted and filtered. The fluid extraction (five and half litres) was mixed with malto dextrin (5%) and then spray dried at 16rpm with an inlet temperature of 160-200°C and outlet temperature of 70-80°C. The free flow powder obtained was stored in an air tight container at room temperature and used for further process. Owing to high dietary fibre in the seed coat and anti-nutritional factors, the above processing was adopted instead of powdering the whole grains.

Cauliflower (*Brassica oleraceae*) leaves were obtained in a single lot from local market; separated from their stalks, washed under running tap water and were blanched for 10 to 15 seconds. After blanching, the leaves were dried at room temperature for 1 to 2 h by spreading on the filter paper followed by drying in freeze drier (Labconco) at -50°C for 7 days, pulverised to fine powder, sieved (20 mesh) and stored in an air tight containers at room temperature for further process.

Similarly, well matured star gooseberry fruits of uniform size, free from bruises were collected from home garden, washed thoroughly with clean water, wiped with soft cloth, deseeded and freeze dried (Ilshin) at -50°C for 9 days till no visible moisture. The freeze dried fruits were pulverised to fine powder and processed as cauliflower leaves.

2) Nutrient Analysis

The processed dehydrated powders of *Panicumsumatrense*, *Brassica oleraceae* and *Phyllanthusacidus* were analyzed for its moisture, ash, carbohydrate, protein, fat, energy, iron,

vitamin C, folic acid, vitamin A, thiamine, riboflavin and fibre content^[8] to substantiate the richness of nutrients especially the micronutrients viz Iron and Vitamin C.

3) Evaluation of Composite Powder Incorporated Recipes

Composite powder at 10 per cent (*Samai* 6.25%, Cauliflower leaves 2.5% and Star gooseberry 1.25%) and 20 per cent level (*Samai* 12.5%, Cauliflower leaves 5% and Star gooseberry 2.5%) was incorporated in commonly consumed Indian recipes such as *chappathi*, *idiyappam*, *paniyaram*, *dosa*, *idly*, *upma*, as well as *incake* and evaluated for its sensory attributes (Appearance, colour, texture, flavour and taste) over standard (control) recipes using five point hedonic scale by semi-trained (N=25) panel members.

Prior to the above, trial preparation with various proportions (10, 20, 30 and 40 per cent) has been made to find the maximum acceptability level. As 30 and 40 per cent were highly unacceptable, only 10 per cent and 20 per cent were included in recipes and evaluated for sensory acceptability as well as micronutrient enhancement. The results were statistically analysed.

3. Result and Discussion

1. Nutrient Composition

Table 1: Nutrient composition of *Panicumsumatrense*, *Brassica oleraceae* and *Phyllanthusacidus*

Nutrients	<i>Panicumsumatrense</i> (spray dried)	<i>Brassica oleraceae</i> (freeze dried)	<i>Phyllanthusacidus</i> (freeze dried)
Energy (Kcal)	452.30	455.94	350.22
Moisture (g %)	4.07	4.77	14.08
Ash (g %)	2.68	5.48	12.92
Protein (g %)	9.24	31.12	6.0
Fat (g %)	5.0	8.0	5.0
Dietary fibre (g %)	4.0	1.8	0.6
Carbohydrate (g %)	78.51	49.88	76.0
Iron (mg %)	100	280	50
Vitamin C (mg %)	13.6	272	40.8
Folic acid (µg %)	40.0	310.0	28.0

Considering vitamin C, *Brassica oleraceae* powder had highest with 272 mg per cent. Freeze dried *Phyllanthusacidus* powder had better retention of vitamin C with 40.8 mg per cent whereas, its fresh leaves had only 4.6 mg per cent^[7]. The spray dried *Panicumsumatrense* had 13.6 mg per cent of vitamin C.

It was found that, all the three food items selected for the study had considerable proportion of folic acid with cauliflower leaves powder having highest (310 mg per cent) followed by *samai* extract powder (40 mg per cent) and star gooseberry powder (28 mg per cent). Also, there found only meagre amount of dietary fibre upon processing of these plant foods.

There was retention of colour, flavour and nutrients at the maximum level upon freeze drying of cauliflower leaves and star gooseberry fruits when compared to nutrients in its fresh form^[3]. The spray dried extracts of *samai* also found to have good proportion of nutrients. The study proves that all the three processed (Spray dried and Freeze dried) powders of under-exploited plant foods were rich in micronutrients

The spray dried *Panicumsumatrense/samai* extracts and freeze dried cauliflower leaves as well as star gooseberries were estimated for its nutrients and the results are depicted in Table 1.

The moisture content of the processed *samai* (spray dried), cauliflower leaves and star gooseberry (freeze dried) were found to be very low with 4.07, 4.77 and 14.08 g per cent respectively when compared to the moisture content in its fresh form (11.5, 80^[3] and 91.9 g per cent^[6] respectively), thus affirming dehydration process.

The dehydrated powders were found to be energy dense with *Brassica oleraceae* being highest (455.94 Kcal) followed by *Panicumsumatrense* (452.30 Kcal) and *Phyllanthusacidus* (350.22 kcal) respectively when compared to its fresh form (66 Kcal and 341 Kcal^[3]).

Among the micronutrient composition, the iron content of *Panicumsumatrense* extract powder was 100 mg per cent which was ten-fold higher than in its whole form (9.3 mg per cent)^[3]. There was a substantial increase in iron content of freeze dried *Brassica oleraceae* powder (280 mg per cent) and *Phyllanthusacidus* powder (50 mg per cent). Whereas, its fresh form had only 40 mg per cent and 3.25 mg per cent of iron respectively^[3].

especially iron, vitamin C, folic acid and very low in fibre content.

2. Acceptability of composite powder in recipes

The overall mean scores for the sensory attributes of the recipes incorporated with composite powder at 10 (V1) and 20 (V2) per cent as described in the methods are depicted in Table 2.

Table 2: Overall mean score of the recipes

S. No	Common recipes	Overall mean score V1	Overall mean score V2
1	<i>Chappathi</i>	4.70 ± 0.70	4.02 ± 0.72
2	<i>Idiyappam</i>	4.00 ± 3.80	3.80 ± 0.80
3	<i>Paniyaram</i>	4.60 ± 0.60	4.10 ± 0.60
4	<i>Dosa</i>	4.40 ± 0.60	4.00 ± 0.80
5	<i>Idly</i>	4.30 ± 0.70	4.00 ± 0.70
6	<i>Upma</i>	4.60 ± 0.50	4.10 ± 0.60
7	<i>Cake</i>	4.40 ± 0.60	4.00 ± 0.60

The recipes were highly acceptable till 20 per cent of composite powder (V2) incorporation. However, *Chappathi*, *paniyaram* and *upma* had highest overall mean score (4.02)

± 0.72 and 4.10 ± 0.60 respectively) when compared to other recipes. There found slight decline in overall mean score of V2 owing to slight after-taste predominant of cauliflower leaves powder. However, it was acceptable. Statistical analysis (ANOVA) for the sensory attributes of all the composite powder incorporated recipes showed a significant difference at $p < 0.05$.

3. Iron and vitamin C composition of Composite powder incorporated recipes

There was an increase in micronutrient composition especially Iron and Vitamin C when compared to standard recipe (control) as indicated in table-3.

Table 3: Iron and vitamin C composition of Composite powder incorporated recipes

S.N	Common recipes	Iron (mg %)			Vitamin C (mg %)		
		C	VI	V2	C	VI	V2
1	Chappathi	4.66	18.05	31.43	0	8.16	16.32
2	Idiyappam	0.7	14.51	28.3	0	8.16	16.32
3	Paniyaram	3.84	15.01	28.64	0	8.16	16.32
4	Dosa	3.84	15.01	28.64	0	8.16	16.32
5	Idly	1.42	15.06	28.69	0	8.16	16.32
6	Upma	1.84	15.6	29.27	11.3	19.5	27.62
7	Cake	1.74	15.34	28.94	0	8.16	16.32

All the recipes had huge increase in the iron (over ten-fold) and vitamin C content (16 times) upon 20 per cent incorporation of processed *Panicum sumatrense*, *Brassica oleraceae* and *Phyllanthus acidus* composite powder. The vitamin C content of *Upma* alone was only twice that of standard recipe, as the other ingredients used in the preparation has considerable amount of vitamin C content.

4. Conclusion

The underutilised plant foods such as *samai*, cauliflower leaves and star gooseberries, upon processing had significant amount of micronutrients which could be used extensively in daily diet as a concentrated source of micronutrients (Iron and vitamin C) to tackle micronutrient malnutrition especially iron deficiency anaemia.

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