Food-to-food Fortification of Rice Flour (*Swarna Cv.)* using Basil, Marjoram and Spearmint Dried Leaves Powder: A Physicochemical and Nutritional Study

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Introduction

Food-to-Food fortification (FtFF) is an emerging technique to enrich nutrient-deficient foods by adding foods with relatively high amounts of one or more micro and macronutrients [1]. However, its application at commercial scale is limited. Thus, an attempt was made to explore the nutritional and physio-chemical effect of dried herbs like basil, marjoram, and spearmint addition, as potential fortificants for rice flour.

Objectives

- To evaluate physio-chemical properties like water absorption index (**WAI**), water solubility index (**WSI**), oil absorption capacity (**OAC**), water absorption capacity (**WAC**) and solubility (**SL**) of fortified rice flour.
- To find out change in iron content and color difference on fortification of rice flour from basil, spearmint and marjoram powders.

Table 1: Different rice-based formulations using basil, marjoram and spearmint

Raw material	Fortification level (gram)			
	B1	B2	B3	B4
Basil	1	2	3	4
SMP	3.4	3.4	3.4	3.4
Rice flour	95.6	94.6	93.6	92.6
	M1	M2	M3	M4
Marjoram	1	2	3	4
SMP	3.4	3.4	3.4	3.4
Rice flour	95.6	94.6	93.6	92.6
	S1	S2	S3	S4
Spearmint	1	2	3	4
SMP	3.4	3.4	3.4	3.4
Rice flour	95.6	94.6	93.6	92.6

B: Basil fortified, M: Marjoram fortified, S: Spearmint fortified; 1, 2, 3, 4 represent % of fortificants

Material and Methods

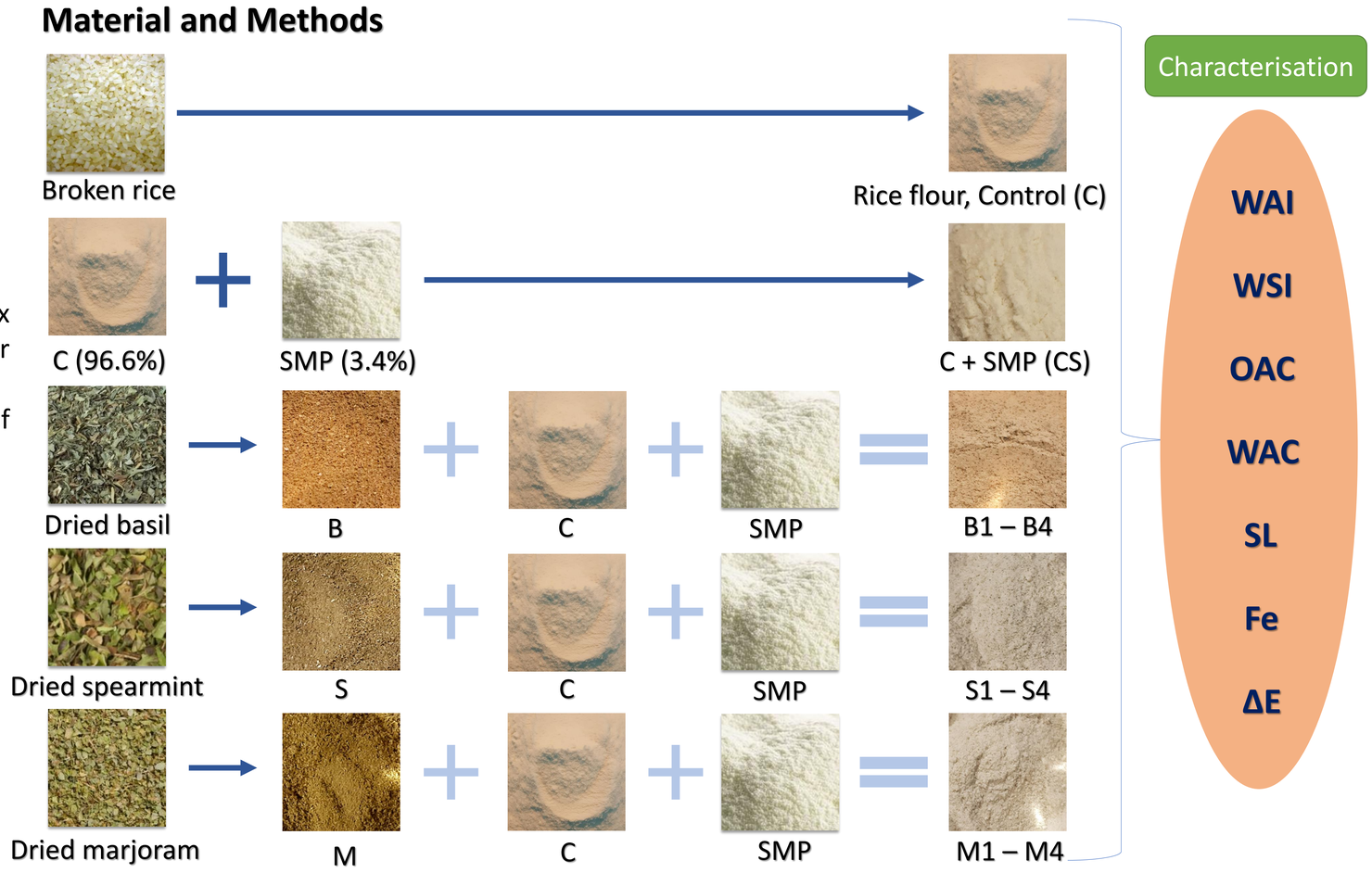

Figure 1: Preparation of different rice-based basil, marjoram and spearmint fortified samples

Results & Discussion

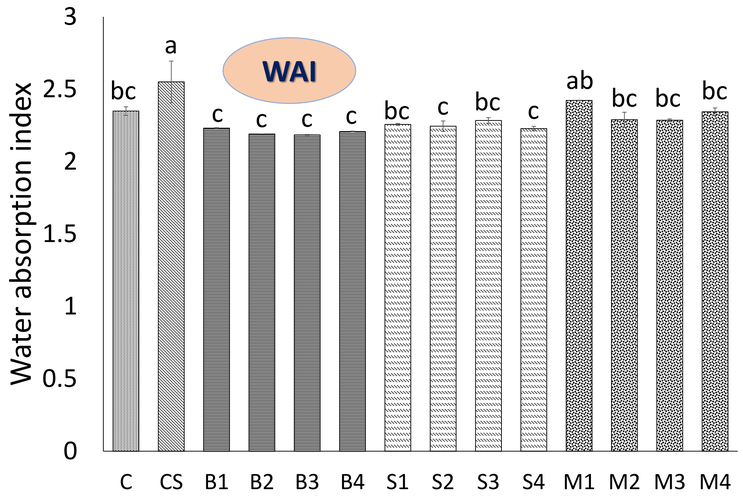

Figure 2: Effect of fortification on WAI of rice flour

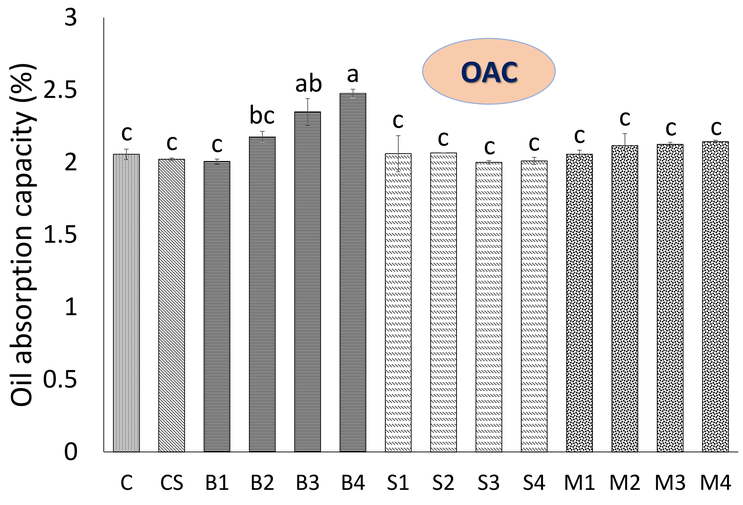

Figure 3: Effect of fortification on OAC of rice flour

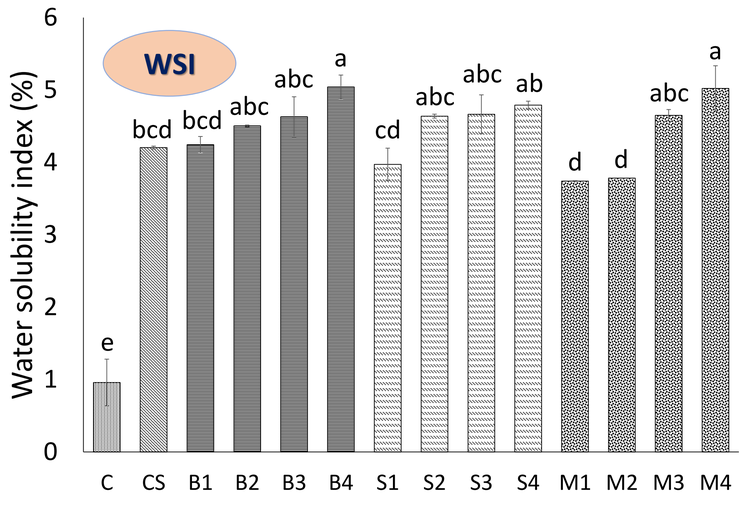

Figure 4: Effect of fortification on WSI of rice flour

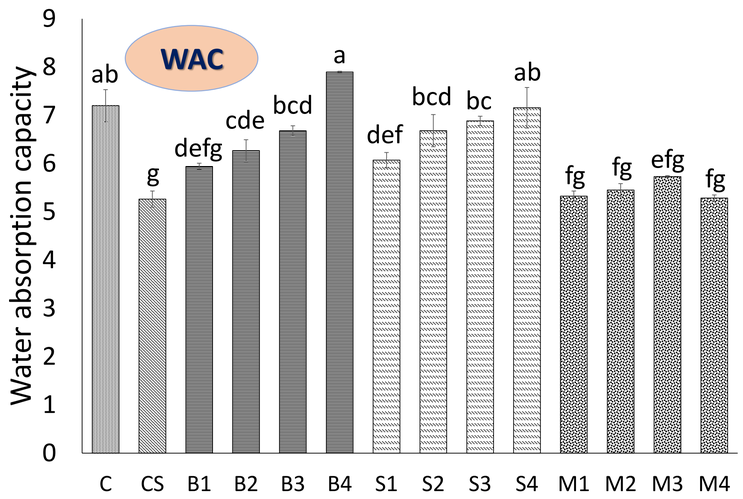

Figure 5: Effect of fortification on WAC of rice flour

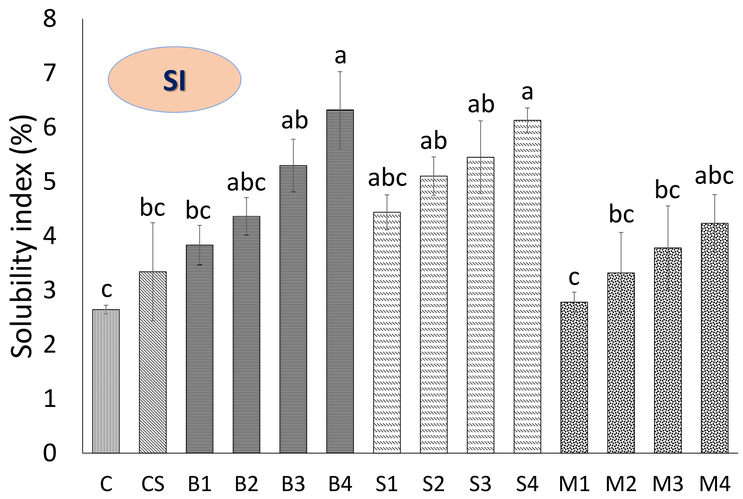

Figure 6: Effect of fortification on SI of rice flour

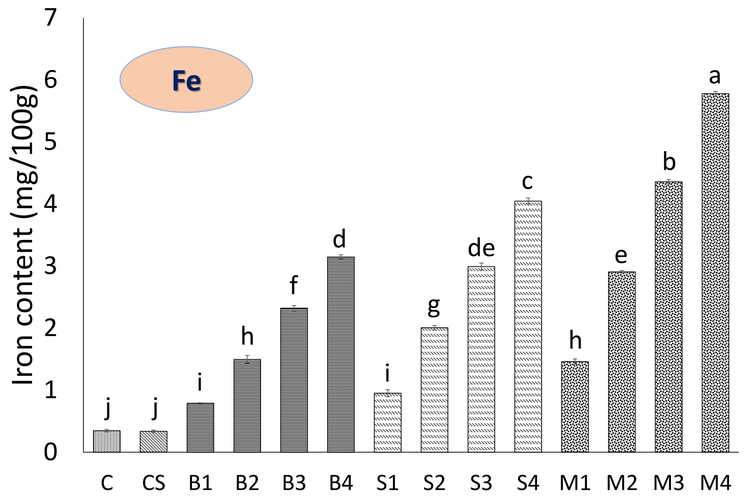

Figure 7: Effect of fortification on Fe content of rice flour

Note: Bars having different letter at end in same graph are significantly different ($p < 0.05$) using Tukey's test.

Summary & Conclusion

- ✓ The basil, spearmint and marjoram fortification did not affect significantly ($p>0.05$) WAI (Figure 2). A similar result was observed in OAC except for basil at 3-4 % fortification level (Figure 3).
- ✓ The WSI of all fortified samples was significantly ($p<0.05$) higher than control sample (Figure 4).
- ✓ The addition of SMP significantly ($p<0.05$) decreased WAC, however, addition of all fortificants increased the WAC (Figure 5). A similar increasing trend in solubility index was observed (Figure 6).
- ✓ The improvement in the iron content was observed upon addition of all fortificants. The highest result were obtained for 4% marjoram fortified sample (Figure 7).
- ✓ All the fortified samples showed significantly higher color difference ($p<0.05$) than the control sample in which marjoram fortified samples were the lowest (Figure 8).

Practical Application

- ✓ The outcomes of the study indicated that the basil, spearmint and marjoram can be used as natural fortificants to improve iron content of the rice-based formulations.
- ✓ This study provides insights use of natural fortificants in formulating FtFF products at commercial scale.

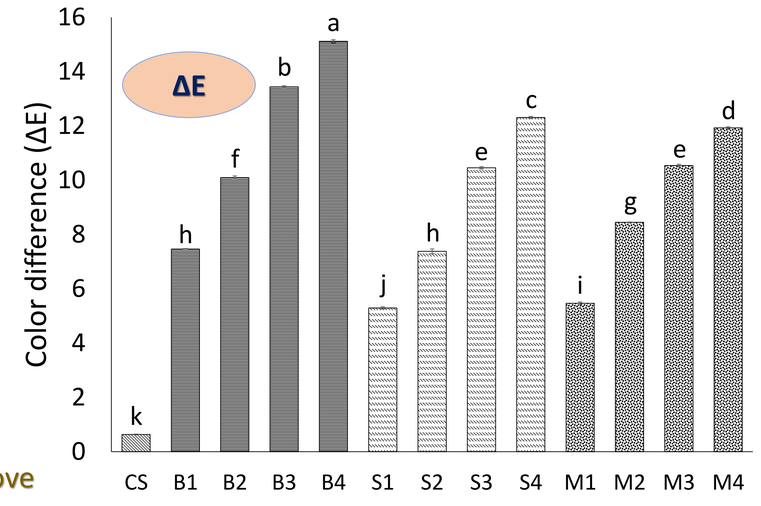

Figure 8: Effect of fortification on ΔE content of rice flour

Reference

1. Kruger, J., Taylor, J. R. N., Ferruzzi, M. G., & Debelo, H. (2020). What is food-to-food fortification? A working definition and framework for evaluation of efficiency and implementation of best practices. Comprehensive Reviews in Food Science and Food Safety, 19(6), 3618–3658. https://doi.org/10.1111/1541-4337.12624