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Assessment of nutritional composition and antioxidant activity of *Chakli* incorporated with dehydrated *Moringa oleifera* and *Solanum nigrum* leaves

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Abstract

The study was carried out with objectives to determine the nutritional composition and antioxidant activity of *Chakli* incorporated with dehydrated *Moringa oleifera* and *Solanum nigrum* leaves. *Chakli* was prepared by utilization of Besan, *Solanum nigrum* and *Moringa oleifera* at 90:5:5 percent, 85:5:10 percent and 85:10:5 percent level referred to as T₁, T₂ and T₃ respectively. and Control was made with basic ingredients without incorporation of leaves mixture. Sensory evaluation for prepared products was done by using 9 Point hedonic scale. Data obtained were statistically analyzed by using ANOVA, Critical Difference and T test. Best treatment from sensory evaluation and control were carried out for nutritional analysis and Antioxidant activity. Analysis was done by using the standard procedure of AOAC. Iron, calcium and Vitamin C contents were determined by Thiocyanate method (colorimetric), volumetric method and 2, 6-Dichlorophenol dye method respectively. Beta carotene content was analyzed by the method given by Ranganna, 2001 while Polyphenol content and % radical scavenging activity were assessed by the Folin-Ciocalteu method and DPPH method respectively. In context with organoleptic attributes Treatment T₂ made with dehydrated leaves mixture (Besan + *Moringa oleifera* and *Solanum nigrum* with the ratio of 85:10:5) were most acceptable in comparison with other treatment, Results shows a significant difference between T₀ and best treatment T₂ in context with Moisture, Ash, Carbohydrate, Energy, Iron, Calcium, Vitamin C and Beta carotene as the calculated value of t is found to be greater than tabulated value of “t” 4.303 which denoted that Moisture, Ash, Carbohydrate, Energy, Iron, Calcium, Vitamin C and Beta carotene content of T₂ is better in comparison with T₀. Where as in context with Antioxidant activity Polyphenolic content, radical scavenging activity (%) and flavanoids content T₂ is better in comparison with T₀.

Keywords: *Moringa oleifera*, *Solanum nigrum*, nutritional composition, antioxidant properties

1. Introduction

Underutilized crops often considered as minor/neglected/under exploited crops were once grown more widely or intensively, but are falling into disuse for a variety of agronomic, genetic, economic and cultural reasons. Farmers and consumers are using these crops less, because they are in some way not competitive with other species in the same agricultural environment. *Moringa oleifera*, an edible tree found worldwide in the dry tropics, is increasingly being used for nutritional supplementation. Its nutrient dense leaves are high in protein quality, leading to its widespread used by Doctors, healers, nutritionist and community leaders, to treat under nutrition and a variety of illnesses. *Moringa oleifera* leaves and it highlights the need for a scientific consensus on the nutritional benefits. One such potential candidate for combating both micro as well as macro- nutrient malnutrition is the *Moringa* leaves (drumstick leaves). Studies have reported the significance of drumstick leaves as a source of vitamin A [1]. *Solanum nigrum* has been extensively used traditionally to treat various ailments such as pain, inflammation and fever. The plant is also used in the Oriental systems of medicine for various purposes – as an antitumorigenic, antioxidant, anti-inflammatory, hepatoprotective, diuretic, and antipyretic agent. Various compounds have been identified which are responsible for diverse activities. It contains Phytochemicals constituent like alkaloids, flavonoids, carbohydrates, glycosides, phytosterols, fixed oil and fats, proteins, phenolic compounds, tannis, saponins [2] *Solanum nigrum* an underutilized and unconventional part of the plant, contains a good amount of antioxidants to counteract the damaging effect of free radicals [3].

2. Objectives

1. To assess organoleptic attributes of *Chakli* incorporated with dehydrated *Moringa oliefera* and *Solanum nigrum* leaves mixture.
2. To determine the nutritional composition and antioxidant activity of *Chakli* incorporated with dehydrated *Moringa oliefera* and *Solanum nigrum* leaves mixture.

3. Materials and Methods

3.1 Experimental site-The experiments was carried out in the Nutrition Research Laboratory, Department of Foods and Nutrition Ethelind School of Home Science, Sam Higginbottom Institute of Agriculture Technology and Sciences, Allahabad.

3.2 Procurement of raw material: Healthy fresh leaves of *Solanum nigrum* and *Moringa oliefera* for the experiment were collected from the university campus of the SHIATS, Allahabad, India.

3.3 Preparation of dehydrated green leaf powder (*Solanum nigrum* and *Moringa oliefera* leaves)

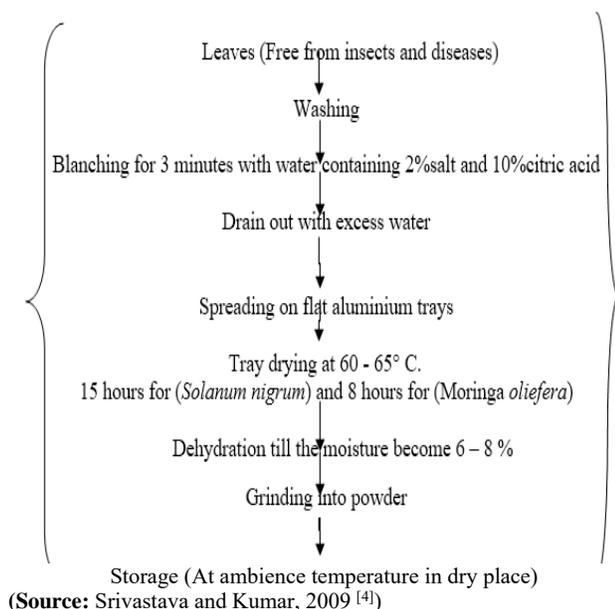


Fig 1: Flow diagram of dehydration of leaves

Table 2: Average sensory scores of different parameters in control and treatments of *Chakli* made from dehydrated leaves mixture.

Treatment	Colour and Appearance	Body and Texture	Taste and Flavour	Overall Acceptability
T ₀	7.87	8.0	8.0	7.9
T ₁	7.8	7.73	7.73	7.70
T ₂	8.06	8.06	8.2	8.08
T ₃	7.2	7.33	7.73	7.36
Result	S	S	S	S
P<0.05, C.D	0.42	0.29	0.23	0.24

The organoleptic scores obtained by “*Chakli*” made from dehydrated leaves mixture (Table-2) shows that in context with overall acceptability, treatment T₂ had the highest score (8.08) (besan+ *Moringa oliefera*+ *Solanum nigrum* leaves with the ratio of 85:10:5) followed by T₀(7.9) (besan100g), T₁(7.70) (besan+ *Moringa oliefera*+ *Solanum nigrum* leaves with the ratio of 90:5:5) and T₃(7.36) (besan+ *Moringa oliefera* + *Solanum nigrum* leaves with the ratio of 90:5:10) respectively.

3.4 Development of the Food Products

Table 1: Treatment and Replications of the *Chakli*.

Control and Treatments	Products and level of incorporation of dehydrated leaves mixture in <i>Chakli</i> .		
	Besan (100%)	<i>Solanum nigrum</i> (%)	<i>Moringa oliefera</i> (%)
T ₀	100	-	-
T ₁	90	5	5
T ₂	85	5	10
T ₃	85	10	5

3.5 Organoleptic Evaluation of prepared food products-Sensory evaluation of the prepared *Chalki* was done with the help of 9 point Hedonic Scale [5].

3.6 Determination of nutritional composition of the prepared products The best treatment and control of the *Chakli* were taken for analysis of their nutritional composition (moisture, ash, protein, carbohydrates, fats, crude fibre, iron, calcium, β carotene, vitamin C, energy) and Antioxidant activity (total phenolic content, Flavanoids and % radical scavenging activity).

The nutrient composition such as Determination of moisture and Ash was done by using standard procedure [6], Determination of protein [7], Determination of crude fat by Soxhlet method, Determination of fibre Extraction method [6]. Determination of carbohydrate by % Carbohydrates = 100 - the sum of (% moisture + % crude protein + % fat + % ash + % crude fiber), Determination of energy value—calculated by multiplying the figure of percentage of protein, fat and carbohydrate by 4, 9, and 4 respectively and adding the figure obtained, Determination of calcium by method [8]. Determination of iron by Thiocyanate method (Colorimeter) [6]. Determination of Vitamin C by Titration method [4], Determination of Beta carotene [6]. Anti-nutritional factors such as oxalates [9] and Phytate was determined [9]. Total phenolic content will be determined by using Folin-ciocalteu reagent [10], Estimation of flavanoids will be done by aluminium chloride method [11], Determination of percent radical scavenging activity by DPPH Radical Scavenging method [12].

3.7 Statistical Analysis The data obtained were statistically analyzed by using analysis of variance technique (two way classification) and critical difference and T- test [13].

4. Results and Discussions

It is revealed from the results that Treatment T₂ was liked very much whereas T₀, T₁, T₃ was moderately liked by the panel of judges This is due to the incorporation of dehydrated *Moringa oliefera* and *Solanum nigrum* leaves at different proportion which may alter overall acceptability of the treatments differently but all the treatments are in the acceptable range in context with overall acceptability according to the panel of judges [14].

Table 3: The average nutritional composition of control and the best treatment samples of the value added *Chakli* made from dehydrated leaves mixture using t-test.

Nutrients	T ₀	T ₂	Difference (T ₀ -T ₂)	T (Calculated)	T (tabulated)	Result
Moisture %	34.3	29.8	4.5	5.06	4.303	S
Ash%	7.97	12.63	-4.66	6.35	4.303	S
Protein (g)	4.3	8.64	-4.34	3.87	4.303	S
Fat(g)	8	9.2	-1.2	2.04	4.303	NS
Crude fiber(g)	0.5	1.6	-1.1	3.27	4.303	NS
Carbohydrate(g)	30	43	-13	11.92	4.303	S
Energy(Kcal)	187	250	-63	4.9	4.303	S
Iron(mg)	2.7	4.02	-1.32	6.01	4.303	S
Calcium(mg)	23	292.43	-269.43	261.12	4.303	S
Vitamin C(mg)	0.85	5.50	-4.65	5.12	4.303	S
Beta carotene(µg)	14.94	4952	-4937.06	4257	4.303	S

S=Significant, NS =Non Significant

The table shows a significant difference between T₀ and best treatment T₂ as the calculated value of t is found to be greater than tabulated value of “t” 4.303 which denoted that Moisture (5.06), Ash (6.35), Carbohydrate (11.92), Energy (4.9), Iron (6.01), Calcium (261.12), Vitamin C (5.12) and Beta carotene (4257) content of T₂ is better in comparison with T₀.

Table 4: Antioxidant composition of control and best treatment of *Chakli* made from dehydrated leaves mixture by using t-test.

Antioxidants	T ₀	T ₂	T ₂ - T ₀	t(calculated)	T(tabulated) value of 5%	Result
Polyphenol (mg/100g)	8	87	79	58.6	4.303	S
Radical scavenging activity (%)	41.9	67	25.1	13.4	4.303	S
Flavonoids (mg)	13.7	94	80.3	64.8	4.303	S

S=Significant, NS =Non Significant

The table also shows a significant difference between Polyphenols content, which denoted that Polyphenols content (58.6), Radical scavenging activity (13.4%) and flavanoids (64.8) content T₂ is better in comparison with T₀

5. Conclusion

It is concluded from the findings that dehydrated leaves mixture of *Moringa oleifera* and *Solanum nigrum* can be successful incorporated in various traditional recipes like *Chakli*. In context with organoleptic attributes Treatment T₂ made with dehydrated leaves mixture (Besan + *Moringa oleifera* and *Solanum nigrum* with the ratio of 85:10:5) were most acceptable in comparison with other treatment. Results shows a significant difference between T₀ and best treatment T₂ in context with Moisture, Ash, Carbohydrate, Energy, Iron, Calcium, Vitamin C and Beta carotene as the calculated value of t is found to be greater than tabulated value of “t” 4.303 which denoted that Moisture, Ash, Carbohydrate, Energy, Iron, Calcium, Vitamin C and Beta carotene content of T₂ is better in comparison with T₀. Where as in context with Antioxidant activity Polyphenolic content, radical scavenging activity (%) and flavanoids content T₂ is better in comparison with T₀

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