EFFECT OF ROASTING ON MICRONUTRIENT RETENTION OF VALUE ADDED PRODUCTS DEVELOPED BY INCORPORATING DEHYDRATED *DAUCUS CAROTA* (TS – 77 {LALI}) AND *BRASSICA OLERECEA* (C/F KARTIKI) LEAF POWDER

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ABSTRACT- **Micronutrient deficiency constitutes a significant public health problem requiring immediate attention from governments, researchers and health care practitioners. In India serious micronutrient deficiency disorders associated with vitamin A, Iron and Iodine are encountered due to dietary insufficiency and are designated as 'hidden hunger'. Despite the fact that several programs have been launched by Government of India to allay this deficiency, the problem still exists in the country with higher magnitude. Researches highlight that food based strategies can prove to be excellent strategy to combat micronutrient deficiency and green leafy vegetables which are treasure trove of nutrients provide variety in terms of color and flavor but their high moisture content result in spoilage. Dehydration which is a simple user friendly, traditional technology helps to convert these vegetables in to crisp form, reducing in size to facilitate the utility throughout the year. Another added advantage of this method is that the dried vegetable powder can be then easily incorporate in to different traditional recipes. Blanching offers destruction or inactivation of enzymes that can affect the color, texture, flavor and nutritional quality, hence improvement in the quality of final produce. In the present study *Daucus carota* (Carrot) and *Brassica olerecea* (Cauliflower) leaves were processed and incorporated in various traditional recipes using roasting as the method of cooking. Effect of cooking was assessed by estimating Iron and Beta carotene both before and after cooking and statically compared.**

Index Terms- Micronutrient malnutrition, Green leafy vegetables, dehydration, Food Based Strategies, value addition

1. INTRODUCTION

Micronutrients play a central part in metabolism and in the maintenance of tissue function. Micronutrients are life sustaining nutrients that are needed only in small quantities for effective functioning of brain, the immune system, reproduction and energy metabolism but their deficiency make a considerable negative impact on health and learning abilities [1]. The World Health Organization 200 identified Iron, Vitamin A and Iodine as the "Big 3" that affect at least one-third of the world's population. Micronutrient deficiency has many adverse effects on human health, not all of which are clinically evident. Thus, in addition to the obvious and direct health effects, the existence of micronutrient deficiency has profound implications for economic development and productivity, particularly in terms of the potentially huge public health costs and the loss of human capital formation **[2]**. The medicinal approach for combating micronutrient deficiencies especially of Vitamin A and Iron is less popular because of lower acceptability of medicines by subjects because of the related side effect [3,4,5]. This indicated to a clear need for a "FOOD BASED APPROACH" which can provide not only one nutrient but different micronutrients and many organizations are now laying stress on this approach **[6]**.

World Health Organization [7] also advocates the use of "Food Based Approach" in facing the problem of micronutrient deficiency. Food based approaches are working as a tool to prevent micronutrient deficiencies. The most sustainable

approaches to increasing the micronutrient status of populations are food based approaches, which include food production, dietary diversification and food fortifications as well as value addition at commercial and household levels. However we have limited literature available which has investigated the effect of cooking on the nutrient retention in the food products. Therefore, in the present study, we prepared several value added products by incorporating blanched and dehydrated *Dacucus Carota* ie carrot and *Brassica Olerecea* ie cauliflower leaf powder and evaluated the effect of method of cooking on micronutrient retention particularly beta carotene and iron content in most acceptable value added product as these were main two micronutrients present in green leaves.

II. METHODS

The fresh leaves of Carrot (*Daucus carota*) and Cauliflower (*Brassica olerecea*) were selected for present study because of their good nutritive value and easily availability. The leaves were procured from International Horticulture Innovation and Training Centre, Durga pura, Jaipur and processed immediately after procurement. The variety of Carrote leaves was TS – 77 (LALI) and variety of Cauliflower leaves was C/F KARTIKI.

A. Processing

The leaves were separated from stalks, washed thoroughly three to four times under the running tap water to remove all the adhering dust. The leaves were then blanched and then dehydrated for blanching they were first exposed to hot water at temperature of 88°C. It was achieved by tying the leaves in a muslin cloth and dipping it into hot water for a specified duration of 5 to 6 minutes. The leaves were then cooled in a tap water (chilled 2°C) in order to reduce bitter taste and make leaves more palatable. Dehydration took place through oven drying. Leaves were then dried to constant weight in oven (60°C) till the leaves became crisp and brittle to touch, blended into fine powder using a blender machine, sieved and stored in a covered container.

B. Selection of the recipe using roasting as method of cooking

Several snack items were prepared by using Roasting as method of cooking . Most of the recipes were carbohydrate based, commonly used by the low income group and middle class people. The products which were prepared by incorporating the *Daucus carota* and *Brassica olerecea* leaves were Khakhra, Atta-ladoo, Besan-ladoo (Sattu), Panjiri .

C. Organoleptic evaluation of recipes

Organoleptic evaluation of all the recipes containing different levels of dried leaf powder was done on the basis of their appearance, color, taste, texture and overall acceptability. At a time, one standard recipe (control or no leaf powder) was cooked and variations were developed by incorporating different levels (5%, 10% and 15%) of dried leaf powder in different recipes. Evaluation was done by 10 semi trained panelists using 5 point hedonic rating scale.

D. Nutritional Analysis

Estimation of Beta carotene content was done spectrophotometrically and Iron content was done by Wong's method. The nutrients retained by both control and most acceptable value added product were calculated and compared. Estimations were conducted in the laboratories of Department of Home science, The IIS University.

III. RESULTS AND DISCUSSION

A. Organoleptic Evaluation

Khakhra:

Khakhra which is wheat flour based roasted product generally eaten as a snack control recepie was prepared without incorporating green leafy vegetables . Experimental products were prepared by replacing 5%, 10% and 15% of the base ingredient with dehydrated *Daucus carota* (Carrot) and *Brassica olerecea* (Cauliflower) leaf powder. The control sample was given score ranging up to 5. Addition of dehydrated *Daucus carota* and *Brassica olerecea* brought down the scores of all the samples with respect to appearance, color, texture, taste and overall acceptability in comparison to control. Samples Incorporated with dehydrated greens at 5% level scored 4 (*Daucus carota*) and 3.8 (*Brassica olerecea*) in terms of the overall acceptability. However, incorporation level of 15%, overall acceptability received the lowest score in case of both the leaves .

Atta-ladoo*:*

In all the fortified products, 5 gram incorporation of dried leaf powder was accepted the most by panel members as the mean scores for overall acceptability were 4 in case of *Daucus carota* (Carrot) incorporated ladoo and 3.9 for *Brassica olerecea* (Cauliflower) leaf incorporated ladoo. However, 10 gram and 15 gram incorporation of dried leaf powder reduced their acceptability because it resulted in rough texture and an unpleasent

appearance. Increased incorporation level resulted in difficulty to roll the ladoos. Bitterness could be felt by the panel members on consumption of ladoos with high proportion of dried leaf powder of *Daucus carota* and *Brassica olerecea*. This bitter grassy flavor and the regurgitation caused by the product adversely affected its overall acceptability. Increasing incorporation of dried leaf powder also resulted in a peculiar dark green color which affected the other sensory attributes like appearance, color, texture.

Besan-ladoo:

Maximum scores were gained by product with 5% incorporation level of dried *Daucus carota* and *Brassica olerecea* leaves. The scores for the overall acceptability of *Daucus carota* (Carrot) laddo and *Brassica olerecea* (Cauliflower) ladoo were found to be 4 and 3.6 respectively. Least acceptable variation of the besan-ladoo was 10 gram and 15 gram incorporation level of both the leaves. Increasing the incorporation level of greens resulted in rough texture and dark green appearance of the product. The panel members disliked these variations due to much high proportion of dried leaf powder of both the leaves (*Daucus carota* and *Brassica olerecea*).

Panjiri:

Incorporation of 5 gram dried leaf powder was well accepted in terms of appearance and texture, while gradual decrease in acceptability scores could be seen as level of leaf powder incorporation increased. Low scores ranging from 1.5-2.5 were observed for 15% *Daucus carota* (Carrot) and *Brassica olerecea* (Cauliflower) incorporated panjiri.

Stastical Analysis of control and most accepted recepie highlighted that there was no significant differences in terms of all sensory attributes. Though the 10% and 15% greens incorporated products were almost similar in texture, the differences in appearance, color and taste were statistically significant. Panel member reported that due to bitter taste and grassy flavor of *Daucus carota* and *Brassica olerecea*, they could feel aftertaste of the product prepared by incorporating 10 and 15 percent green leaf powder resulting into reduced acceptability and it also caused regurgitation after consumption.

B. Effect of Roasting on Nutrient Retention (iron and beta carotene; control vs most acceptable recipe)

Khakhra:

Nutritional estimations were performed before and after cooking results highlighted that the beta carotene content of control recipe was to be 35.56 µg/100g (before cooking) and 34.43 µg/100g (after cooking), the percent reduction being 3.2%. In the case of *Daucus carota* (Carrot) leaves incorporated Khakhra, beta carotene content was 794.12 µg/100g (before cooking) and 773.67 µg/100g (after cooking), the percent reduction being 2.6% whereas in the case of *Brassica olerecea* (Cauliflower) leaves incorporated Khakhra, beta carotene content was 884 µg/100g (before cooking) and 864.45 µg/100g (after cooking), the percent reduction being 2.2%. The iron content of the control recipe was 5.32 mg/100g (before cooking) and 5.14 mg/100g (after cooking), the percent decrement being 3.4%. In the case of Khakhra prepared by *Daucus carota* (Carrot) leaves, iron content was 9.84 mg/100g (before cooking) and 9.51 mg/100g (after cooking), the percent decrement being 3.45 whereas, in the case of *Brassica olerecea* (Cauliflower) incorporated Khakhra, iron content was 16.44 mg/100g (before cooking) and 15.83 mg/100g (after cooking), the percent reduction was 3.7%.

Atta-ladoo:

The nutritive value of *Daucus carota* (Carrot) and *Brassica olerecea* (Cauliflower) incorporated Atta-ladoo was evaluated and a marginal increase in the beta carotene and iron content in comparison with the control was reported. The beta carotene content of control recipe was estimated to be 264.65 µg/100g (before cooking) and 254 µg/100g (after cooking), the percent reduction being 4%. In the case of *Daucus carota* (Carrot) leaves incorporated Atta-ladoo, beta carotene content estimated to be 948 µg/100g (before cooking) and 906.47 µg/100g (after cooking), the percent reduction being 4.3% whereas in the case of *Brassica olerecea* (Cauliflower) leaves incorporated Atta-ladoo, beta carotene content was analyzed to be 1047.36 µg/100g (before cooking) and 1005.35 µg/100g (after cooking), the percent reduction being 4%. The iron content of the control recipe was analyzed to be 8.34 mg/100g (before cooking) and 8 mg/100g (after cooking), the percent decrement being 4%. In the case of Atta-ladoo prepared by *Daucus carota* (Carrot) leaves, iron content was estimated to be 11.37 mg/100g (before cooking) and 10.93 mg/100g (after cooking), the percent decrement being 3.9% whereas, in the case of *Brassica olerecea* (Cauliflower) incorporated Atta-ladoo, iron content was estimated to be 18.08 mg/100g (before cooking) and 17.38 mg/100g (after cooking), the percent reduction was 3.9% Besan-ladoo:

The beta carotene content of control recipe was estimated to be 545.49 µg/100g (before cooking) and 525.32 µg/100g (after cooking), the percent reduction being 3.7%. In the case of *Daucus carota* (Carrot)

leaves incorporated Besan-ladoo, beta carotene content was estimated to be 1291.62 µg/100g (before cooking) and 1237.76 µg/100g (after cooking), the percent reduction being 4% whereas in the case of *Brassica olerecea* (Cauliflower) leaves incorporated Besan-ladoo, beta carotene content was analyzed to be 1393.74 µg/100g (before cooking) and 1346.45 µg/100g (after cooking), the percent reduction being 3.4%. The iron content of the control recipe was analyzed to be 13.53 mg/100g (before cooking) and 12.96 mg/100g (after cooking), the percent decrement being 4.2%. In the case of Besan-ladoo prepared by *Daucus carota* (Carrot) leaves, iron content was estimated to be 17.53 mg/100g (before cooking) and 16.78 mg/100g (after cooking), the percent decrement being 4.2% whereas, in the case of *Brassica olerecea* (Cauliflower) incorporated Besan-ladoo, iron content was estimated to be 24.65 mg/100g (before cooking) and 23.64 mg/100g (after cooking), the percent reduction was 4.1% .

Panjiri:

Beta carotene content in the control recipe of panjiri was estimated to be 586 µg/100g (before cooking) and 563.41 µg/100g (after cooking), the percent reduction being 3.9%. In the case of *Daucus carota* (Carrot) leaves incorporated Panjiri, beta carotene content estimated to be 1337.26 µg/100g (before cooking) and 1292.55 µg/100g (after cooking), the percent reduction being 3.3% whereas in the case of *Brassica olerecea* (Cauliflower) leaves incorporated Panjiri, beta carotene content was analyzed to be 1396 µg/100g (before cooking) and 1347.42 µg/100g (after cooking), the percent reduction being 3.5%. The iron content of the control recipe was analyzed to be 8.56 mg/100g (before cooking) and 8.18 mg/100g (after cooking), the percent decrement being 4.4%. In the case of Panjiri prepared by *Daucus carota* (Carrot) leaves, iron content was estimated to be 11.36 mg/100g (before cooking) and 10.93 mg/100g (after cooking), the percent decrement being 3.9% whereas, in the case of *Brassica olerecea* (Cauliflower) incorporated Panjiri, iron content was estimated to be 18.59 mg/100g (before cooking) and 17.86 mg/100g (after cooking), the percent reduction was 3.9%.

From this it can be interpreted that incorporation of dehydrated greens made the value added products rich sources of micronutrients and even after cooking significant retention was observed in the products. Results revealed that the maximum beta carotene and iron content was retained by Khakhra in comparison to the other products prepared by roasting like Atta-ladoo, Besan-ladoo and Panjiri. Cooked products have variations in carotenoids composition brought by varying cooking conditions (time and temperature), type of vegetables and the interaction between them. From this it can be concluded that as the time duration and temperature of roasting increased, the retention of both the micronutrients decreased. Because Khakhra was prepared on low flame and time taken for cooking was much less than other products hence maximum retention of micronutrient was observed in Khakhra. (Table 2)

IV. CONCLUSIONS

The result of present investigation highlighted that The present research reflected that there is an urgent need for promotion of some horticulture intervention techniques targeted towards cultivation of beta carotene and iron rich foods and the uncommon alternate sources such as *Daucus carota* (Carrot) and *Brassica olerecea* (Cauliflower) leaves. As they are very rich sources of micro nutrients and low in cost. Due to their perish ability, this rich source remains untapped. However by simple household techniques like blanching and dehydration we can ensure their availability and can be used for value addition. Consumption of value added products should be encouraged both in the National and regional supplementary feeding programs at the household and commercial level.

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Appendices

Table No 1

Organoleptic evaluation (Control Vs Value added)

KHAKHRA					
Daucus carota	Appearance	Color	Taste	Texture	Overall acceptability
Control	5±0.01	5±0.02	5±0.01	5±0.01	5±0.01
5%	**3.9^{NS}±0.02**	**4.2 ^{NS}±0.03**	**3.7 ^{NS}±0.01**	**4.5 ^{NS}±0.03**	**4 ^{NS}±0.04**
10%	2.3 ^{SS}±0.03	2.7 ^{SS}±0.02	2.2 ^{SS}±0.03	3 ^{SS}±0.03	3.2 ^{SS}±0.01
15%	1.1 ^{SS}±0.02	1.5 ^{SS}±0.03	1.4 ^{SS}±0.01	1.8 ^{SS}±0.04	1.7 ^{SS}±0.02
S	0.010*****	0.025*****	0.043*****	0.031*****	0.026*****
Brassica olerecea	Appearance	Color	Taste	Texture	Overall acceptability
Control	5±0.01	5±0.02	5±0.01	5±0.01	5±0.01
5%	**3.4 ^{NS}±0.02**	**4.1 ^{NS}±0.03**	**3.5 ^{NS}±0.01**	**4.6 ^{NS}±0.01**	**3.8 ^{NS}±0.04**
10%	2.1 ^{SS}±0.03	2.4 ^{SS}±0.02	2 ^{SS}±0.03	3.1 ^{SS}±0.03	3.1 ^{SS}±0.01
15%	1.1 ^{SS}±0.02	1.2 ^{SS}±0.03	1.1 ^{SS}±0.01	1.6 ^{SS}±0.04	2 ^{SS}±0.02
S	0.015*****	0.009*****	0.025*****	0.021*****	0.033*****
ATTA- LADOO					
Daucus carota	Appearance	Color	Taste	Texture	Overall acceptability
Control	5±0.02	5±0.03	5±0.01	5±0.03	5±0.02
5%	4.2^{NS}±0.02	4.3 ^{NS}±0.02	4.7 ^{NS}±0.04	4.2 ^{NS}±0.02	4 ^{NS}±0.01
10%	3.7 ^{SS}±0.01	3.9 ^{SS}±0.03	3.9 ^{SS}±0.04	3.5 ^{SS}±0.02	3.7 ^{SS}±0.03
15%	2.7 ^{SS}±0.03	2.5 ^{SS}±0.03	1.8 ^{SS}±0.02	1.6 ^{SS}±0.04	1.9 ^{SS}±0.01
S	0.020*****	0.034*****	0.021*****	0.026*****	0.023*****
Brassica olerecea	Appearance	Color	Taste	Texture	Overall acceptability
Control	5±0.02	5±0.03	5±0.01	5±0.03	5±0.02
5%	**3.9^{NS}±0.02**	**4.1 ^{NS}±0.02**	**4.3 ^{NS}±0.04**	**4.1 ^{NS}±0.02**	**3.9 ^{NS}±0.01**

10%	3.5 ^{SS}±0.01	3.4 ^{SS}±0.03	3.4 ^{SS}±0.04	3.1 ^{SS}±0.02	3.3 ^{SS}±0.03
15%	2.5 ^{SS}±0.03	2.3 ^{SS}±0.03	1.4 ^{SS}±0.02	1.3 ^{SS}±0.04	1.5 ^{SS}±0.01
S	0.024*	0.040*	0.032*	0.028*	0.033*
BESAN LADOO					
Daucus carota	Appearance	Color	Taste	Texture	Overall acceptability
Control	5±0.01	5±0.04	5±0.02	5±0.02	5±0.01
5%	**4.4 ^{NS}±0.02**	**4.2 ^{NS}±0.02**	**4.4 ^{NS}±0.04**	**4.1 ^{NS}±0.03**	**4 ^{NS}±0.02**
10%	3.5 ^{SS}±0.01	3.7 ^{SS}±0.04	3.7 ^{SS}±0.01	3.2 ^{SS}±0.03	3.4 ^{SS}±0.02
15%	2.5 ^{SS}±0.01	2.8 ^{SS}±0.03	2.7 ^{SS}±0.04	1.7 ^{SS}±0.01	2.1 ^{SS}±0.01
S	0.020*	0.034*	0.037*	0.021*	0.022*
Brassica olerecea	Appearance	Color	Taste	Texture	Overall acceptability
Control	5±0.01	5±0.04	5±0.02	5±0.02	5±0.01
5%	**4.2 ^{NS}±0.02**	**4.1 ^{NS}±0.02**	**4.1 ^{NS}±0.04**	**3.8 ^{NS}±0.03**	**3.6 ^{NS}±0.02**
10%	3 ^{SS}±0.01	3.2 ^{SS}±0.04	3.4 ^{SS}±0.01	2.9 ^{SS}±0.03	3.1 ^{SS}±0.02
15%	2.1 ^{SS}±0.01	2.2 ^{SS}±0.03	2.1 ^{SS}±0.04	1.3 ^{SS}±0.01	1.6 ^{SS}±0.01
S	0.046*	0.032*	0.021*	0.023*	0.036*
PANJIRI					
Daucus carota	Appearance	Color	Taste	Texture	Overall acceptability
Control	5±0.02	5±0.03	5±0.01	5±0.01	5±0.02
5%	4.6 ^{NS}±0.02	4.3 ^{NS}±0.03	4.2 ^{NS}±0.01	4.3 ^{NS}±0.02	3.9 ^{NS}±0.02
10%	3.3 ^{SS}±0.02	3.6 ^{SS}±0.01	3.2 ^{SS}±0.04	3.6 ^{SS}±0.03	3.1 ^{SS}±0.01
15%	2.4 ^{SS}±0.03	2.5 ^{SS}±0.03	1.7 ^{SS}±0.02	1.5 ^{SS}±0.02	2.2 ^{SS}±0.01
S	0.006*	0.023*	0.027*	0.021*	0.032*
Brassica olerecea	Appearance	Color	Taste	Texture	Overall acceptability
Control	5±0.02	5±0.03	5±0.01	5±0.01	5±0.02
5%	**4.6 ^{NS}±0.02**	**4.3 ^{NS}±0.03**	**4.2 ^{NS}±0.01**	**4.3 ^{NS}±0.02**	**3.9 ^{NS}±0.02**
10%	3.3 ^{SS}±0.02	3.6 ^{SS}±0.01	3.2 ^{SS}±0.04	3.6 ^{SS}±0.03	3.1 ^{SS}±0.01
15%	2.4 ^{SS}±0.03	2.5 ^{SS}±0.03	1.7 ^{SS}±0.02	1.5 ^{SS}±0.02	2.2 ^{SS}±0.01
S	0.025*	0.021*	0.038*	0.041*	0.035*

Mean ±Standard deviation, *Significant at 5% level, NS: Non Significant, SS: Statistically Significant, (t-test at 5% level)

Table No 2

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Effect of Roasting on nutrient content (Beta carotene and Iron content)

Recipes	Beta carotene (µg)			Iron (mg)		
	Control	*Daucus carota*	*Brassica olerecea*	Control	*Daucus carota*	*Brassica olerecea*
Khakhra						
BC	35.56±0.04	794.12±0.06	884±0.04	5.32±0.03	9.84±0.05	16.44±0.06
AC	34.43^{NS}±0.03	773.67±0.02	864.45±0.01	5.14±0.02	9.51±0.03	15.83±0.04
% red	3.2%	2.6%	2.2%	3.4%	3.4%	3.7%
Atta-ladoo						
BC	264.65±0.04	948±0.03	1047.36±0.07	8.34±0.05	11.37±0.03	18.08±0.04
AC	254±0.03	906.47±0.01	1005.35±0.02	8±0.02	10.93±0.01	17.38±0.03
% red	4%	4.3%	4%	4.1%	3.9%	3.9%
Besan-ladoo						
BC	545.49±0.05	1291.62±0.04	1393.74±0.01	13.53±0.07	17.53±0.04	24.65±0.01
AC	525.32±0.01	1237.76±0.02	1346.45±0.01	12.96±0.03	16.78±0.03	23.64±0.04
% red	3.7%	4%	3.4%	4.2%	4.2%	4.1%
Panjiri						
BC	586±0.03	1337.26±0.04	1396±0.03	8.56±0.04	11.36±0.03	18.59±0.02
AC	563.41±0.02	1292.55±0.03	1347.42±0.04	8.18±0.01	10.93±0.02	17.86±0.01
% red	3.9%	3.3%	3.5%	4.4%	3.9%	3.9%

Mean ±Standard deviation, BC: Before cooking, AC. After cooking, red: reduction, NS: Non Significant

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