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NUTRITIVE VALUE OF FOODS COOKED IN SOLAR BOX COOKER

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Use of solar energy offers a practical solution for the household energy problem, which is clouding the prospects of mankind. Use of solar energy as a medium of cooking has been identified for a long time but practiced only in a limited way. From time to time many solar energy based cooking devices have been designed and its performance effeciently stuided. Studies from our laboratories have identified solar box cookers as a feasible cooking gadget especially at the household level and is appreciated by housewives and increasingly used by population groups. While feasibility studies on the use of these cookers are available, comparative nutritive profiles of foods using these solar cookers as against the common methods of cooking are not widely available. Hence the objetives of the study.

It aims at bringing out the effect of solar cooking using box cookers on the nutritive value of four commonly used foods in comparison with the ordinary cooking method, namely cooking by abosorption method.

The specific objetives of the study are:

1. To compare the nutritive value of four foods cooked using solar box cooker and ordinary absorption method of cooking.

2. To find out the time taken for cooking the selected foods in the solar cooker.

3. To assess the acceptability of foods cooked in the solar cooker.

METHODLOGY:

The cooking methods included mere solar cooking and absorption method of cooking. A universal solar box cooker was chosen for cooking using solar energy. Ordinary cooking by absorption method was chosen as this is the method of cooking still adopted in our villages. Four foods commonly used namely amaranth (Amaranthus gangeticus), carrot (Daucus carota), beans (Phaseolus vulgaris) and cabbage (Brassica oleracea) were chosen for cooking in this study. The experiment involved were cooking of the selected foods in water without seasoning. Cooking procedures were standardized by preliminary experiments. Based on the standardized procedures, the selected foods were prepared in triplicate both in solar cooker and by ordinary cooking. The time taken for cooking the selected foods in both these methods were recorded. The temperature variations within the solar cooker while cooking the foods were noted every one hour. The mean scores for acceptability of the various foods in terms of

colour, appearance, texture, flavour and taste were judged by a panel of 10 members. The nutrient content of the raw and cooked foods was analysed for protein (Kjheltec method), minerals such as calcium, phosphorus and iron vitamins like carotone, thiamine, riboflavin and vitamin C by standard procedures recomended by National Institute of Nutrition.

RESULTS AND DISCUSSION

A. Time taken for cooking the selected foods:

Table I gives the time taken for cooking the selected foods in both methods of cooking.

TABLE I
TIME TAKEN FOR COOKING THE SELECTED FOODS (MINUTES)

Food	Absorption method	Solar Cooking
Amaranth	8	45
Carrot	15- 18	60
Beans	15	60
Cabbage	15	50

The taken taken for cooking in solar cookers ranged from 45-60 minutes while it was 8- 18 minutes when cooked using absorption method of cooking.

B. Temperature cariation while cooking the selected items in the solar cooker:

The temperature variations for every one hour while cooking the selected foods is given in the Table II.

TABLE II
TEMPERATURE (°C) VARIATIONS IN SOLAR COOKER

Time (Hrs)	Temperature			
	Ist Trial	2nd Trial	3rd Trial	Mean
12:40	88	88	100	92
13:40	100	105	120	108.9

The maximum steadily increased to a mean maximum of 108° C at 1340 hours (1:40 pm).

C. Palatability of the cooked foods:

Table III gives the mean scores obtained for palatability of the foods cooked in solar cooker and by ordinary cooking.

TABLE III
MEAN SCORES FOR PALATABILITY OF THE FOODS COOKED BY BOTH METHODS

Criteria	Amaranth		Carrot		Beans		Cabbage	
	C	SC	C	SC	C	SC	C	SC
Apperance	19.0	19.0	18.0	19.0	19.5	19.0	18.8	18.6
Colour	18.0	18.0	18.5	19.5	19.3	19.0	18.8	18.7
Flavour	19.5	19.0	19.0	19.5	19.5	19.5	18.8	18.0
Texture	18.5	18.3	18.3	19.0	18.8	18.8	18.7	18.7
Taste	18.3	18.3	18.7	19.3	18.6	18.6	19.0	19.1
Total	93.3	92.6	91.5	96.3	95.7	94.9	94.1	93.1

C- Absorption method of cooking S- Solar cooking

Appearance, colour, flavor, texture and taste were better or similar for foods cooked using solar box as against the absorption method of cooking except for the flavour in cabbage. The mean scores obtained for carrots cooked in solar cooker is much higher compared to other vegetables. But the flavour developed in solar cooked cabbage was not acceptable though the taste was good. However, on a comparative basis there was not much difference in the acceptability of products cooked using both the methods thus bringing out the feasibility of using solar energy in cooking these foods.

D- Nutritive value of the selected foods:

i. Table IV gives the nutrient content of amaranth cooked using both methods.

TABLE IV
NUTRIENT CONTENT OF AMARANTHUS COOKED USING DIFFERENT METHODS

Nutrient	Raw	Cooking Abs. Method	% loss	Cooking Solar	% loss
Protein (g)	3.8	3.7	2.7	3.7	2.7
Calcium (mg)	320	315	1.6	307	4.1
Phosphorus (mg)	58	55	5.2	58	0
Iron (mg)	3.8	3.6	5.3	3.7	2.7
Carotene (mcg)	26520	12600	52.5	15552	41.4
Thiamine (mg)	0.06	0.03	50	0.05	16.7
Riboflavin (mg)	0.45	0.39	13.4	0.39	13.4
Vitamin C (mg)	78	65	16.7	60	23.1

When compared to the raw amaranthus, the percentage loss of protein and riboflavin in both methods of cooking was found to be similar. While there was no loss of calcium and and vitamin C in the solar cooked sample was more when compared to that of the cooked sample by absorption method. The percentage loss of phosphorus, carotene and thiamine was less in solar cooking when compared to absorption method of cooking.

ii. Table V gives the nutrient content of carrots cooked using both the methods of cooking.

TABLE V
NUTRIENT CONTENT OF CARROTS COOKED USING DIFFERENT METHODS

Nutrient	Raw	Cooking Abs. Method	% loss	Cooking Solar	% loss
Protein (g)	1.1	1.04	5.5	0.9	18.2
Calcium (mg)	99	93	6.1	95	4.0
Phosphorus (mg)	325	318	2.2	323	0.7
Iron (mg)	1.3	1.1	15.4	1.0	23.1
Carotene (mcg)	13305	7516	43.6	5308	60.2
Thiamine (mg)	0.02	0.01	50	0.01	50
Riboflavin (mg)	0.04	0.02	50	0.03	25
Vitamin C (mg)	9	6	33.4	7.8	13.4

When compared with the raw sample, the percentage loss of iron, phosphorus, calcium, vitamin C and riboflavin was less in solar cooking than absorption method of cooking. The percentage loss of protein and carotene was higher in the solar cooked sample than in the sample cooked by absorption method. The percentage loss of thiamine was found to be similar in both the methods.

iii. Table VI presents the nutrient content of beans cooked using both the methods of cooking.

TABLE VI
NUTRIENT CONTENT OF BEANS COOKED USING DIFFERENT METHODS

Nutrient	Raw	Cooking Abs. Method	% loss	Cooking Solar	% loss
Protein (g)	1.4	1.0	28.6	1.2	14.3
Calcium (mg)	78	58	25.7	65	16.7
Phosphorus (mg)	35	30	14.3	28	20.1
Iron (mg)	0.9	0.7	22.3	0.8	11.2
Carotene (mcg)	795	708	11.0	721	9.4
Thiamine (mg)	0.09	0.05	44.5	0.06	33.4
Riboflavin (mg)	0.13	0.11	15.4	0.11	15.4
Vitamin C (mg)	18	15	16.7	16	11.2

When compared with the raw sample, the percentage loss of riboflavin in beans cooked by both the methods of cooking was found to be similar amounting to 15.4 %. The percentage loss of protein, calcium, iron, thiamine, vitamin C and carotene was less in solar cooking compared to that of absorption method. The percentage loss of phosphours in solar cooking was more compared to absorption method.

iv. The nutrient content of cabbage cooked using different methods of cooking is presented in Table VII.

TABLE VII
NUTRIENT CONTENT OF CABBAGE COOKED USING DIFFERENT METHODS

Nutrient	Raw	Cooking Abs. Method	% loss	Cooking Solar	% loss
Protein (g)	1.5	1.4	4.1	1.4	4.1
Calcium (mg)	43	39	9.4	42	2.4
Phosphorus (mg)	55	52	5.5	50	9.1
Iron (mg)	0.5	0.3	40	0.4	20
Carotene (mcg)	488	81.6	83.3	184	62.8
Thiamine (mg)	0.08	0.06	25	0.06	25
Riboflavin (mg)	0.14	0.10	28.6	0.12	14.3
Vitamin C (mg)	157	138	12.2	140	10.9

While the percentage loss of protein and thiamin in both methods of cooking was similar, the percentage loss of calcium, iron, vitamin C, riboflavin and carotene was less in solar cooking when compared to that of absorption method. The percentage loss of phosphours was more in solar cooking as compared to absorption method.

E. Percentage Retention of Nutrients in the Selected Foods:

The percentage retention of nutrients in the selected foods cooked in solar cooker and by absorption method of cooking is shown in Table VIII.

TABLE VIII
PERCENTAGE RETENTION OF NUTRIENTS

Nutrients	Amaranth		Carrot		Beans	Beans	Cabbage	
	C	SC	C	SC	C	SC	C	SC
Protein	97.3	97.3	94.5	81.8	71.4	85.7	96	96
Calcium	98.4	95.9	93.9	96.0	74.3	83.3	91	98
Phosphorus	94.8	100	97.8	99.3	95.7	79.9	95	91
Iron	94.7	97.3	84.6	76.9	77.7	88.8	60	80
Carotene	47.5	58.6	56.4	39.8	89.0	90.6	17	38
Thiamine	50.0	83.3	50.0	55.5	55.5	66.6	75	75
Riboflavin	86.6	86.6	50.0	75.0	84.6	84.6	71	86
Vitamin C	83.3	76.9	66.6	86.6	83.3	88.8	88	89

***C = Cooked** ***SC = Solar Cooked**

In general, retention of protein and riboflavin did not show much variation between the methods for all the vegetables, but for amaranthus, except for vitamin C, solar cooking gave better retentions. Whereas for carrot, retention of iron, carotene and vitamin C seems to be better when cooked by absorption method. Beans again retained more of nutrients like calcium, iron, carotene, and vitamin C when cooked using solar cooker and the same was true for cabbage.

From this table if we compare the profile of nutrients among all the foods cooked by both the methods of cooking, solar cooking ranks the highest depicting the feasibility of the method for use and conserve the nutrients.

CONCLUSION:

The results of this experiment indicates that nutrition retention for nutrients like iron, carotene and vitamin C is better or comparable in all the four foods studied and gives a pointer for further studies along these lines. Studies using single foods and recipes are under way. It is also recommended that comparative studies using different designs of solar cooker may also be under taken.

It is encouraging to note that use of solar energy by no means is detrimental to the nutritive content of the vegetables establishing the feasibility of using this readily and abundantly available source of energy especially in countries like ours. Moreover, the fact that foods cooked by solar cooking was equally well accepted as using the absorption method, further enhances the feasibility of its usage in every day cooking. While more indepth studies on these comparative nutritive people is envisaged, it is heartening to note that use of solar energy is not risking the nutrient content of foods cooked in it. It is recommended that future households may plan their houseplans to build in solar cookers and place the kitchen at such a point that the natures gift will be abundantly used in daily cooking and save not only energy but also time and money and manage the availa-bility of resources with great efficiency. Such planning would also enable working women to use mumerous devices at one time to cook their meals and save time to get the work without tension.