

Development of nutritional bakarwadi with incorporation of cauliflower leaves powder

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■ **Abstract** : Cauliflower is the most common cruciferous vegetables largely grown in India. Cauliflower leaves use nowhere because it has higher waste index. Cauliflower leaves are rich in beta carotene and iron. The fresh leaves collected. Fresh leaves were washed then blanched them for 2 minutes at 80^o C. The drying techniques used in the present study for dehydration were Sun drying, Tray Drying, Microwave Drying at different temperatures until constant weight obtained. Dried cauliflower leaves using tray drier (40^oC for 9 hours). 100g cauliflower leaves powder contained 6.07% moisture, 18.19% protein, 0.73% Ash, 1.33% Fat, 11.33% Fibre, 73% Carbohydrate, 66.44% iron, 5.23% beta carotene. Therefore cauliflower leaves powder utilized in Bakarwadi, Thus reducing wastage. The refined flour, Gram flour was blended with cauliflower leaves powder in the ratios of 50:50:0, 50:45:5, 50:40:10, 50:35:15 separately for development of nutritional Bakarwadi. The developed product stored in LDPE and HDPE packaging material for 60 days, the changes observed on the basis of sensory characteristics. On the basis of sensory evaluation, Bakarwadi prepared from 50:45:5 refined flour Gram flour: Cauliflower Leaves powder was well-balanced with good acceptability and store ability of developed nutritional Bakarwadi.

■ **KEY WORDS** : Cauliflower leaves powder, Drying methods, Chemical composition of powder, Product

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One of the cruciferous vegetables is cauliflower (*Brassica oleraceae* L. Var. Botrytis) in the species *brassica oleracea*, in the family Brassicaceae. Cauliflower (*Brassica oleraceae* L. var. Botrytis) is popular vegetables grown largely in India. The name of cauliflower is derived from two Latin words, *caulis* and *floris*. Cauliflower introduced by Jimson at Saharanpur during the period of East India Company. Cauliflower is originated from wild cabbage known as *cole worts* (Swarup and Chatterjee, 1972).

Cauliflower leaves are rich in nutrients but

cauliflower leaves come into waste category. Cauliflower leaves neglected by people in their consumption pattern because it is treated as waste. It is a rich source of beta-carotene and iron thus can be utilized in various products (Kowsalya and Sangeetha, 1999). There are many varieties of cruciferous vegetables which are good sources of iron and other micronutrients. India is second rank in the world in the production of vegetables and third rank in production of fruits (Boer and Pandey, 1997). Vitamin E, Vitamin C, Folate and other important nutrients like phytonutrients, salsforaphane and indole-3-

carbinol are also rich in cauliflower leaves (Antosiowicz *et al.*, 2008; Fowke *et al.*, 2006). Several medical properties contains a cauliflower leaves. It prevents symptoms of anemia and it contains foliate which help in making and stimulating the blood (Brittenham, 2009).

The total productions of cauliflower contribute about 50% leaves are available for a short period after drying can be stored for use during lean season (Singh *et al.*, 2005). The dried cauliflower leaves highly nutritious and it contain moisture -6.07%, Protein- 18.19%, Fat -1.33% Fibre-11.33%, Iron-66.44%, b-carotene 5.23%.

Brassica vegetables as excellent sources of pharmaceuticals as well as beneficial effect on human health. Many compounds have been detached from cauliflower vegetables and its play important role in human health. Some compound of cauliflower vegetables may apply antinutritive effects on human body. These products if noted in routine diet can help to reduce iron deficiency anemia. so the cauliflower leaves powder were used for development of value added product to overcome the health related problems like prevent anemia, cancer diseases.

In this work cauliflower leaves powder was used in the formulation of Bakarwadi. Additionally the present study was carried out to developed Bakarwadi with good acceptability with supplementation of dried cauliflower leaves powder with good acceptability, store ability and sensory characteristics of the developed Bakarwadi.

Objectives :

- Drying of cauliflower leaves by using different drying methods.
- To study the physico-chemical properties of cauliflower leaves powder.
- Development of nutritional Bakarwadi with incorporation of cauliflower leaves powder.
- To study the shelf life of developed Bakarwadi.

■ METHODOLOGY

Raw material :

Cauliflower (*Brassica oleraceae*) fresh leaves were collected from local market of Aurangabad city, India. These Cauliflower leaves are suitable for human consumption because It contain high amount of Beta carotene and iron rich.

Steps for dehydration of cauliflower leaves :

The following different method can be used for dehydration of cauliflower leaves.

Sorting:

Selection of fresh leaves by removed un-damaged, non-insect, infested, discoloured decayed before washing the leaves.

Washing:

After collection of fresh leaves were washed under running of tap water for remove of dirt and for the reducing microbial load.

Blanching:

Blanching is one of the pretreatment given to leafy vegetables for minimize the microbial load and deactivation of enzymatic activity to prevent the browning reaction before drying. Leaves kept for blanch in a stainless steel pan for 2 min at 80°C. After blanching the leaves were dry by following three different techniques.

Drying Technology :

The techniques used in the present study for dehydration were Sun drying, Cabinet tray drying and Microwave drying.

Sun drying:

After blanching leave spread on filter paper then filter paper put on tray. Tray were placed in a direct sunlight on a roof away from traffic, animal and dust and turned casually to secure even drying. The leaves were dried until the constant weight obtained. sun drying is carried out for 5-7 days at moisture content-6-8%.

Cabinet tray drying:

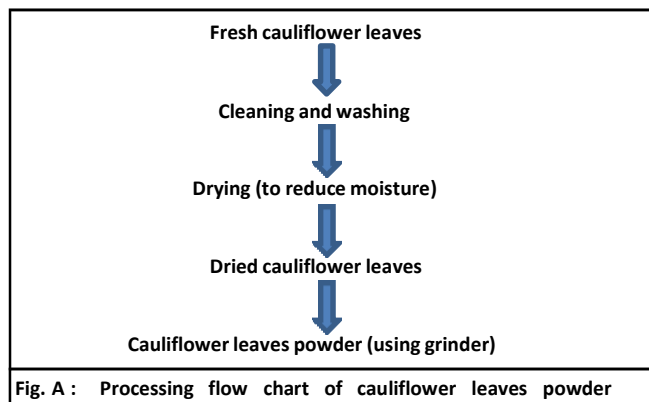
After blanching in this technique blanched leaves spread on tray and placed in cabinet dryer. Drying was carried out at different temperature 40°C, 50°C, 60°C, 70°C, 80°C until the constant weight is obtained.

Oven drying:

Blanching leaves spread in single layer on tray then tray placed in oven. Drying was carried out at different temperature 180W, 360W, 540W, 720W, 900W until the constant weight is obtained.

Storage:

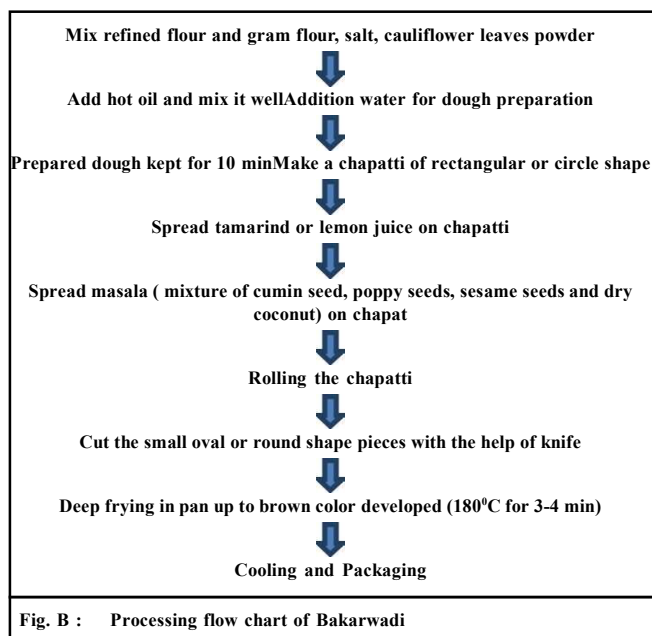
After drying dehydrated leaves grinded into mixer to get fine powder and packed in low density polyethylene bags for further use.

**Standardization of the product :**

Refined flour, Gram flour, salt, sugar, garam masala, sesame seeds, poppy seeds, dry coconut, red chilli, cumin seeds, tamarind etc. (Table A and B).

Ingredients	Quantity
Refined flour	50 g
Gram flour	45 g
Salt	1.5 g
Water	70ml
Sugar	20g
Garam masala	4 g
Sesame seeds	26 g
Poppy seeds	3 g
Dry coconut	28 g
Red chilli	3 g
Cumin seeds	3 g
Tamarind	15 g

Treatments	% Leaves powder	Refined flour	Gram flour
T ₀	0%	50%	50%
T ₁	5%	50%	45%
T ₂	10%	50%	40%
T ₃	15%	50%	35%

**RESULTS AND DISCUSSION**

The results obtained from the present investigation as well as relevant discussion have been summarized under following heads :

Tray drying :

The moisture loss data obtained at different temperature ranges has been shown in Table 1.

As shown in Table 2, T (40°C) sample content highest protein content, fibre content, and iron content, carbohydrate content as compared to other sample. Thus, T (40°C) sample were best nutritional value. On the basis of nutritional composition I have selected T (40°C sample).

Microwave oven drying :

The moisture loss data obtained at different temperature ranges has been shown in Table 3.

Sun drying method :

Sun drying is the most common drying methods in tropical and subtropical countries, due to the fact that they are relatively cheap processes when compared to other. The moisture loss data obtained at different temperature ranges has been shown in Table 4.

The sample of cauliflower leaves powder (Sample S₁, Sample S₂, Sample S₃) was subjected to chemical

Table 1 : Moisture content obtained by tray drying of cauliflower leaves

Time (Hrs.)	Moisture per cent				
	(T ₁) 40 ^o C	(T ₂) 50 ^o C	(T ₃) 60 ^o C	(T ₄) 70 ^o C	(T ₅) 80 ^o C
0	50	50	50	50	50
1	77	98	70	68	17
2	57	77	34	38	15.6
3	39	66	23	28	14
4	27	51	19	18	13
5	21	41	15	14	13
6	17	25	12	14	
7	16	18	12		
8	15	18			
9	15				

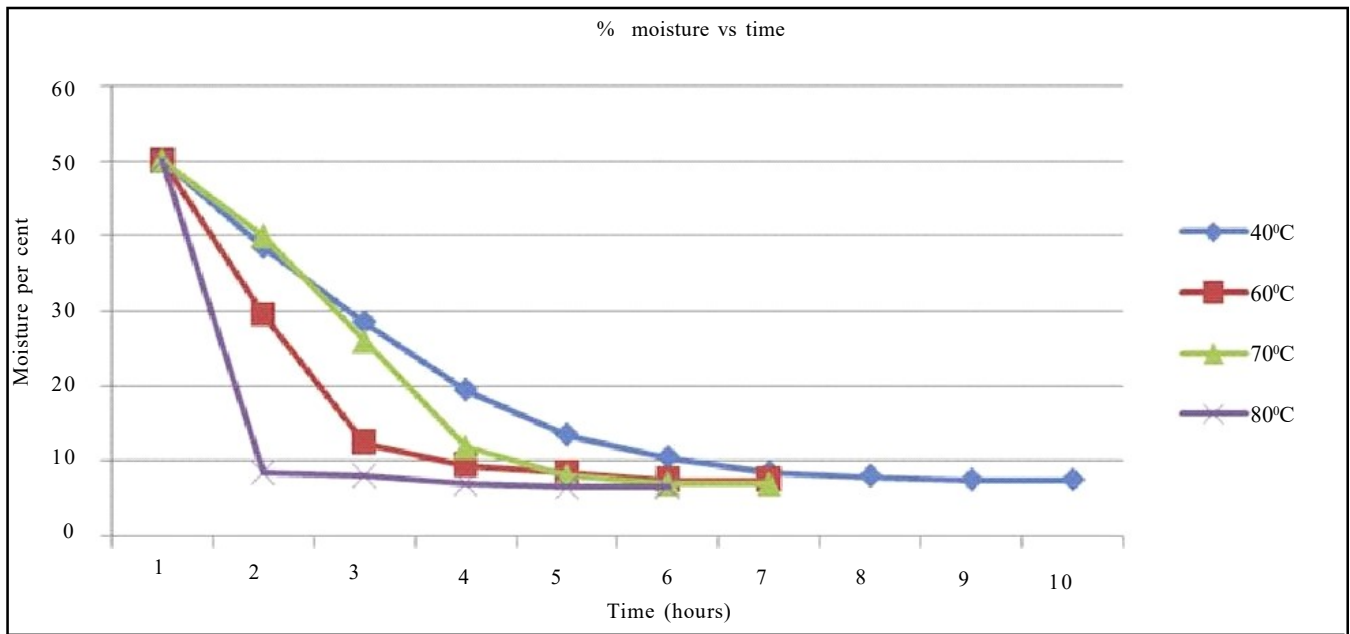


Fig. 1 : Rate of moisture loss at different temperatures

Table 2 : Chemical composition of cauliflower leaves powder

Sr. No.	Constituents	Sample T ₁ (40 ^o C)	Sample T ₂ (50 ^o C)	Sample T ₃ (60 ^o C)	Sample T ₄ (70 ^o C)	Sample T ₅ (80 ^o C)
1.	Moisture (%)	6.07±1.00	5.43±1.91	7.20±2.40	5.90±1.82	6.33±2.30
2.	Protein (%)	18.19±0.56	16.89±0.30	15.71±0.92	15.24±0.56	14.30±0.78
3.	Ash (%)	0.73±0.05	0.83±0.05	0.86±0.05	0.76±0.05	0.83±0.05
4.	Fat (%)	1.33±0.57	2.00±0.00	1.33±0.57	2.33±0.57	2.33±0.57
5.	Fibre (%)	11.33±1.15	8.33±0.57	6.33±1.02	4.67±0.57	4.67±0.57
6.	Carbohydrate (%)	73±1.38	74.84±1.59	74.88±1.58	75.76±2.26	75.53±3.08
7.	Iron (%)	66.44±0.00	66.11±0.01	65.42±0.01	64.40±0.00	63.09±0.01
8.	β carotene (%)	5.23±0.00	5.20±0.00	5.21±0.00	5.21±0.0	5.20±0.00

*Each value is a mean of three determinations

Table 3 : Moisture content obtained by microwave oven drying of cauliflower leaves

Time (Min.)	Moisture per cent				
	(M ₁) 180W	(M ₂) 360W	(M ₃) 540W	(M ₄) 720W	(M ₅)900W
0	100	100	100	100	100
5	93.63	93.63	93.63	93.63	93.63
10	92	72	71	60	37
15	82	44	30	10	10
20	67	16	14	10	10
25	48	14	14		
30	37	14			
35	25				
40	12				
45	11				
50	11				

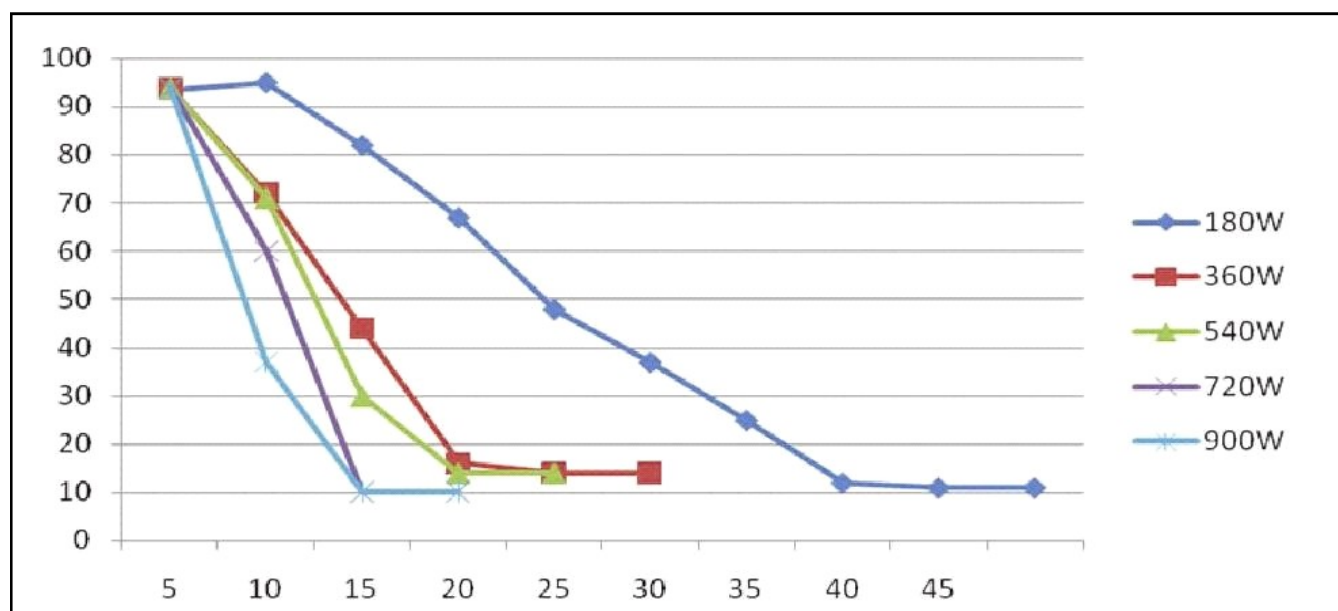


Fig. 2 : Rate of moisture loss at different temperature

Table 4 : Chemical composition of cauliflower leaves powder

Sr. No.	Constituents	Sample M ₁ (180W)	Sample M ₂ (360W)	Sample M ₃ (540W)	Sample M ₄ (720W)	Sample M ₅ (900W)
1.	Moisture (%)	5.33±0.56	3.97±1.79	3.97±1.79	5.10±1.08	4.00±0.65
2.	Protein (%)	13.18±0.10	13.62±0.64	12.62±0.10	12.31±0.19	11.87±0.28
3.	Ash (%)	1.23±0.57	1.23±0.57	1.17±0.57	1.37±0.57	1.50±0.1
4.	Fat (%)	1.67±0.57	1.67±0.57	3.00±0	4.00±0	2.67±0.57
5.	Fibre (%)	8.33±1.52	5.00±1	6.67±0.57	5.33±0.57	3.00±1
6.	Carbohydrate (%)	79.51±1.85	79.51±1.85	79.25±1.71	77.22±1.01	80.21±0.31
7.	Iron (%)	66.01±0.00	66.29±0.00	66.03±0.02	65.29±0.01	65.29±0.01
8.	β carotene (%)	5.02±0.02	5.05±0.00	5.04±0.0.0	5.03±0.01	5.00±0.00

*Each value is a mean of three determinations

Table 5 : Moisture content obtained by sun drying of cauliflower leaves

Time	Moisture per cent		
	S ₁	S ₂	S ₃
0	400	400	400
1	59	71.25	78.75
2	30.75	45.75	66.25
3	21	30	33.75
4	13.75	21.25	21.25
5	12.5	15.5	12.5
6	11.75	10.75	11.75
7	11.5	10	11.5
8	11.5	10	11.5

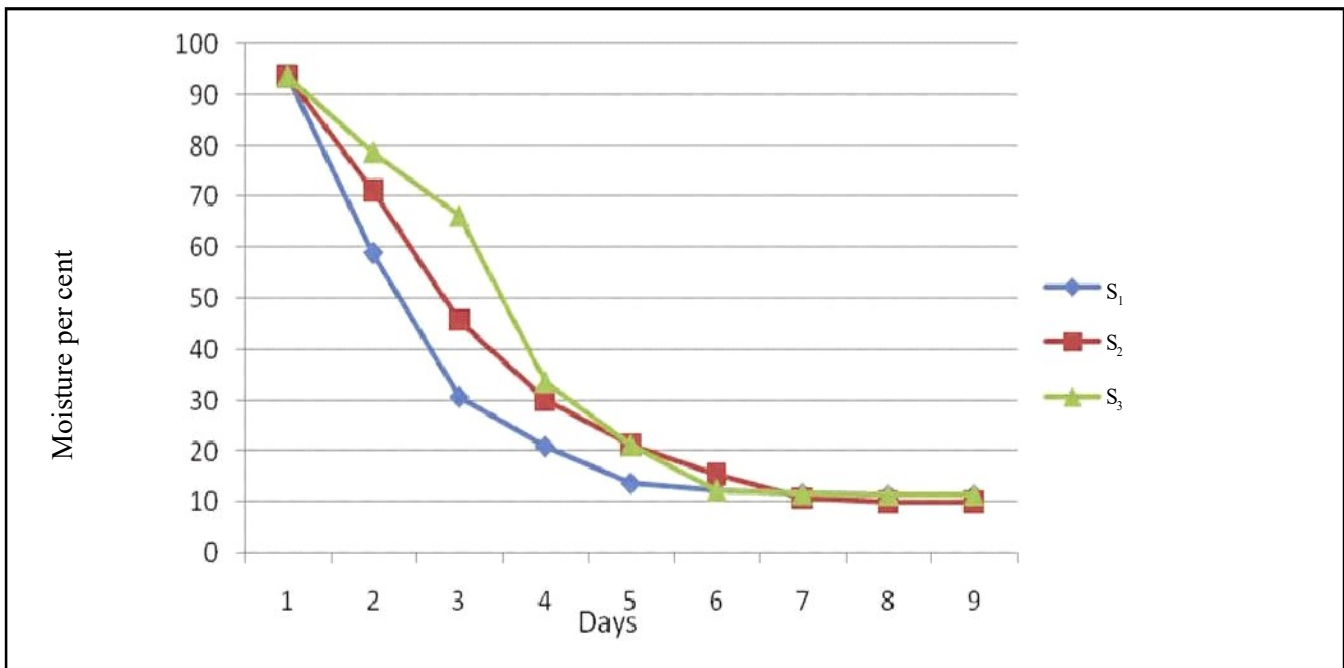


Fig. 3 : Rate of moisture loss at per day

Table 6 : Chemical properties of cauliflower leaves powder

1.	Constituents	Sample S ₁	Sample S ₂	Sample S ₃
2.	Moisture (%)	6.57±1.06	6.33±0.75	6.67±0.57
3.	Protein (%)	11.41±0.15	11.52±0.41	11.47±0.13
4.	Ash (%)	1.43±0.57	1.33±0.05	1.33±0.57
5.	Fat(%)	2.33±0.57	2.67±0.57	2.33±0.57
6.	Fibre (%)	8±1.15	7.33±0.57	7.67±0.57
7.	Carbohydrate (%)	78.25±1.05	77.41±0.84	77.63±0.73
8.	Iron (%)	63.03±0.02	62.81±0.13	63.69±1.13
	β carotene (%)	4.38±0.00	4.39±0.060	4.38±0.01

* Each value was an average of three determinations

Table 7 : Detailed calculation of developed Bakarwadi

Sr. No.	Constituents	Sample T ₀	Sample T ₁	Sample T ₂	Sample T ₃
1.	Moisture (%)	41.02±0.27	41.37±0.28	43.26±1.71	40.59±0.40
2.	Protein (%)	5.59±0.00	6.64±0.00	7.69±0.00	9.35±0.47
3.	Ash (%)	4.57±0.11	3.27±0.11	3.33±0.57	3.33±0.57
4.	Fat(%)	36.58±0.02	36.95±0.00	37.30±0.00	37.68±0.00
5.	Fibre (%)	1.66±0.00	2.767±0	2.467±0	2.043±0.00
6.	Carbohydrate (%)	12.00±0.13	11.77±0.38	8.42±2.28	9.05±0.41
7.	Iron (%)	22.76±0.00	26.01±0.00	29.31±0.00	32.69±0.00
8.	β carotene (%)	0.00±0	4.53±0.02	8.55±0.04	9.03±0.00

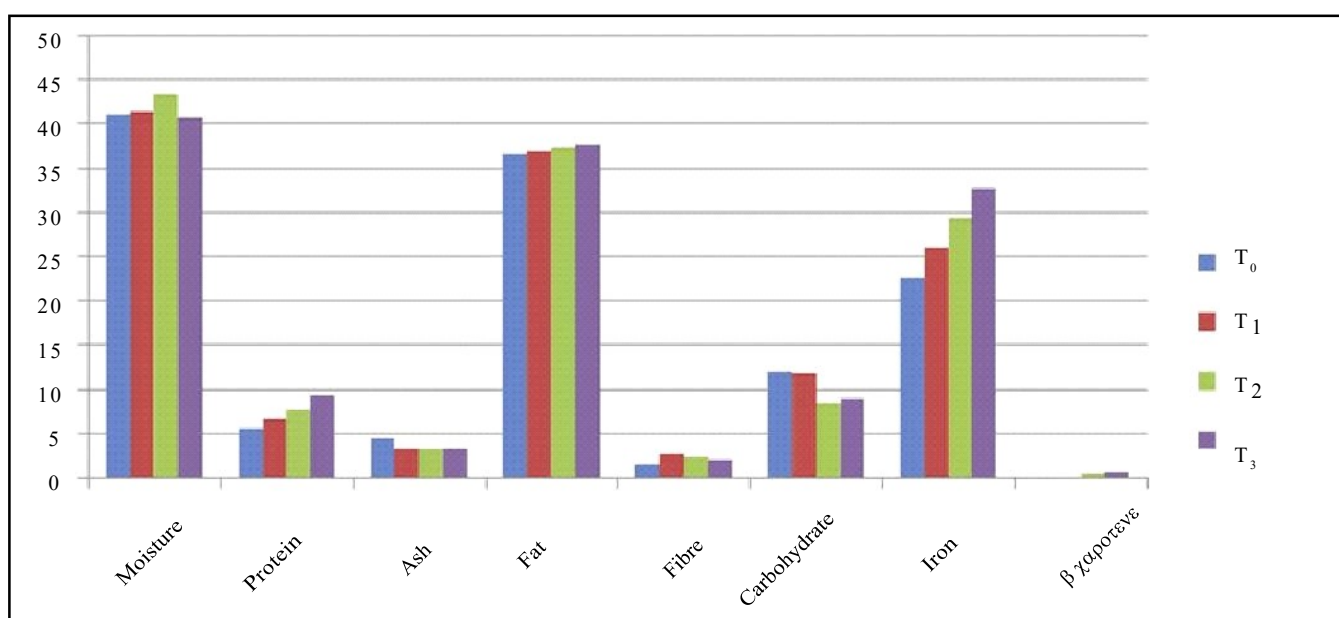
*Each value was an average of three determinations

*control= 0% cauliflower leaves powder

* T₁=5% Cauliflower leaves powder

*T₂=10% cauliflower leaves powder

*T₃=15% cauliflower leaves powder

**Fig. 4 : Proximate analysis of product**

analysis and the result obtained are presented in following Table 6.

The result for the analyzed Bakarwadi that there is a good increase in nutrient value from control sample to sample. There is good increase in the content of Iron.

The data for proximate composition of Bakarwadi prepared by using different level of cauliflower leaves powder is graphically presented in Fig. 4.

Sensory evaluation of Bakarwadi :

The Bakarwadi from different levels of cauliflower leaves powder and control sample were subjected to sensory evaluation for colour, taste, texture, crispiness, and overall acceptability. Result pertaining to sensory

evaluation of Bakarwadi are presented in Fig. 5 and expressed by taking mean and standard deviation. The sensory evaluation was carried out by semi trained nine pannel members by using 9 point hedonic scale assigning scores 9 (like extremely) to 1 (dislike extremely). The values were compared with Bakarwadi from refine flour, gram flour (control sample). The result showed that T₁ (5% cauliflower leaves powder substitution) improved the sensory characteristics *i.e.* colour, taste, texture, crispiness, and overall acceptability of the Bakarwadi. While T₂ and T₃ (with 10% and 15% level of cauliflower leaves powder respectively) was least accepted by the judges. Sample T₁ was selected with highest sensory scores (8.5).

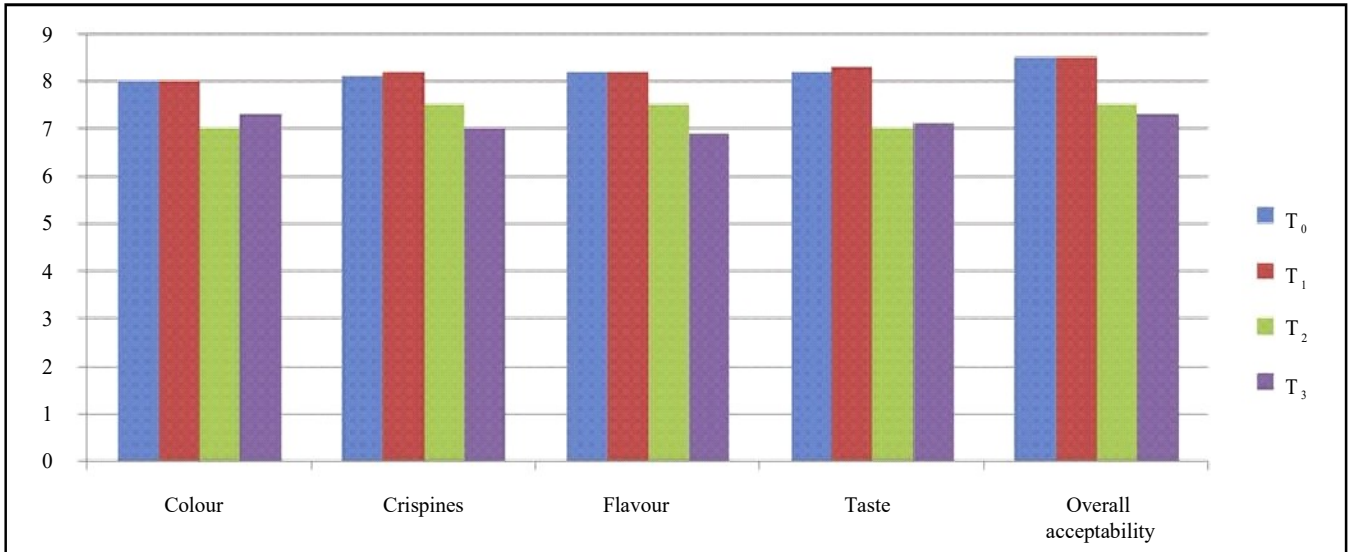


Fig. 5 : The data for sensory evaluation of Bakarwadi

	Days	Colour		Crispiness		Flavour		Taste		Overall acceptability	
		C	T ₁	C	T ₁	C	T ₁	C	T ₁	C	T ₁
HDPE (Packaging Material)	15	8.5	8.0	8.3	8.4	7.8	7.7	7.8	7.7	7.8	7.9
	30	8.0	8.0	8.1	8.0	8.1	8.0	8.1	8.0	8.1	7.9
	45	8.0	7.5	8.1	8.2	7.9	8.0	7.9	8.0	8.5	8.2
	60	7.3	7.3	8.0	8.1	8.0	8.2	8.0	8.2	8.5	8.6
	Mean	7.97	7.70	8.13	8.18	7.95	7.98	8.23	8.0	8.18	8.40
	SD±	0.49	0.35	0.12	0.17	0.12	0.20	0.34	0.1	0.12	0.29
LDPE (Packaging Material)	15	8.0	8.1	8.0	8.1	7.4	7.5	7.5	7.6	8.2	8.0
	30	7.9	7.8	7.7	7.6	8.0	7.8	8.0	7.8	8.1	8.0
	45	7.9	7.3	8.0	8.0	7.8	7.7	8.0	7.9	8.0	8.5
	60	7.2	7.0	7.5	7.2	7.5	7.2	7.5	7.3	7.5	7.0
	Mean	7.75	7.55	7.80	7.73	7.68	7.55	7.75	7.6	7.95	7.88
	SD±	0.36	0.49	0.24	0.41	0.27	0.26	0.28	0.2	0.31	0.62

The data for sensory evaluation of Bakarwadi sample are graphically presented Fig. 5.

Storage study for Bakarwadi by using LDPE and HDPE packaging material on the basis of sensory analysis :

The storage studies for standarized and prepared Bakarwadi sample T₁ (Refine flour 50%, Gram flour 45% and cauliflower leaves powder 5%) and control sample (Refine flour 50% and Gram flour 50%) stored at

ambient temperature for 60 days were evaluated by panel of judges on 9 point hedonic scale. Good packaging protects the food from physical, microbiological and chemically changes. The effect of packaging material *i.e.* LDPE, HDPE and storage period at ambient conditions. The mean sensory scores for Bakarwadi for sensory attributes such as colour, taste, crispiness, flavor and overall acceptability are presented under following Table 8. The storage study revealed that Bakarwadicould be stored at ambient temperature for more than 60 days.

The HDPE package was most acceptable on basis of retention of sensory quality of Bakarwadi during storage with respect to storage condition and period.

Conclusion :

As survey generally in India The cauliflower leaves are use no where. They are treated the waste. No trade business take place of cauliflower leaves. Eventually it gets waste even though being highly nutritious with Beta carotene and iron in larger proportion. The usage of this cauliflower leaves in food products can bring the drastic changes in upgrading the nutritious value of food product. This can benefit for millions of consumer and economically backward people. On the basis of sensory evaluation results show that the maximum 5% cauliflower leaves powder could be incorporated to prepared best acceptable quality of iron rich Bakarwadi. From the study clear that cauliflower leaves powder is good supplement which can be use to prevent anemia diseases and will increase the hemoglobin content of the anemic adolescents. The Bakarwadi is very popular in market and expensive. Using the cauliflower leaves powder in Bakarwadi as contain can increased the nutritional value. The cauliflower leaves which are generally treated as waste and no economic value in the markets can be utilized in a better way, to enrich the Life.

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