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## Value addition and storage study of khakhra fortification with garden cress seed (*Lepidium sativum*)

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**Abstract**

Khakhra is a popular vegetarian roasted 'Gujarati' Indian thin cracker bread or snack item made from whole-wheat flour and oil. In present investigation efforts were made to prepare khakhra by using different proportions and variety of flours i.e. S0, S1, S2, S3, and S4. The study was carried out to find out the development of value added khakhra by using different levels of flours whole-wheat flour, garden cress seed and buckwheat flour. The khakhra was prepared by wheat flour with substituting garden cress seed and buckwheat flour by increasing proportional 10%, 20%, 30% and 40%. The nutritional value like fat, protein and iron content increases with increase the proportion of composite flour. In conclusion substitution of whole-wheat flour with garden cress seed flour and buckwheat flour will be the good nutritional food for iron deficiency people. The storage studies was carried out by three month and chemical composition checked by 30 days time of interval in that 30, 60, 90 days.

**Keywords:** *Khakhra*, garden cress seed, buckwheat, storage study

**Introduction**

Khakhra is a traditional ready-to-eat snack or breakfast item popular in the North Western part of India. This product is very popular in the state of Gujarat. As a convenient snack it is popular during travels because it does not require any further processing at the point of consumption, need minimal packaging and has long shelf life. A nutritious Indian diet snack. Very crispy, crunchy, mouthwatering tasty nutritious and very light in weight snack. Favorite among children and teenagers. Available in many different flavors. It is usually eaten with coffee, tea, chutney, pickles, butter, ghee, topped vegetable, cheese or yoghurt. Easy to carry and most of the people of Gujarat carry these as snack during travel. Khakhra is one of the famous traditional Gujarathi snacks commonly prepared from wheat flour and most preferred food item among all age groups. Hence, an attempt was made to develop value added barnyard millet Khakhra. Three types of Khakhra namely, plain, pulse and vegetable Khakhra were developed Surekha *et al.* (2014) [6]

Value addition of khakhra from fortified Garden cress seed powder will give the people novel profits. It will further provide consumers a new alternative to traditional khakhra. More over this research will bring a new potential to the existence after consumption. Today, we find that the people are becoming more aware about their health and various problems related to it. Thus, with changing life style and the changing mindsets of people they are also making a trend towards eating nutritious as well as that remaining healthy or becoming fit should be accompanied by having such food, which is liked for that individual (Solanke *et al.*, 2018) [11] Garden cress has been consider as an important nutritional and medicinal plant in India since the Vedicera. Seeds are also rich source of omega 3-fatty acids which helps to lower cholesterol patients. Garden cress are well known for their various enthanopharmacological properties (Patil *et al.*, 2015) [3]

Garden cress are used in South Asia as traditional medicine to treat bronchitis, asthma and cough. Garden cress (*Lepidium sativum*) belonging to the family Brassicaceae (Cruciferae) (Richa *et al.*, 2017) [8]. India has the highest prevalence of iron-deficiency anemia among women in the world. More than 60 per cent of adolescent girls are affected by nutritional anemia. Garden cress seeds (*Lepidium sativum*) are locally available inexpensive seeds which are excellent

sources of iron, protein, and  $\beta$ -vitamin. Keeping this in view, the present study was undertaken with the objective to develop commonly consumed food preparations by incorporating roasted and soaked garden cress seeds by applying different cooking methods Kaur (2015) [12] garden cress seeds were analyzed for the nutritional composition and results revealed that 100 g of seeds contain 4.24 g moisture, 26.32 g protein, 27.80 g fat, 7.05 g crude fiber, 29.97 g carbohydrate and 475 Kcal energy. Minerals such as calcium, phosphorus, iron, zinc, copper and manganese were found to be 253.46, 418.35, 6.48, 2.37, 2.31 and 1.52 mg respectively. Vitamins viz  $\beta$ -carotene, vitamin C and total tocopherol were 236.00  $\mu$ g and 16.34 mg and 98.54 mg respectively. Among the developed products control sample scored higher values for all sensory attributes followed by products prepared with five per cent incorporated seeds. Value-added products developed from the seeds had acceptable sensory attributes Shwetha *et al.* (2017) [10]

The seeds of buckwheat medium-sized, three-shape, gray in color or black ranging in length 3- 6 mm, the weight of thousand grain 26-32 gm., seeds are rich in protein 16%, carbohydrates 62%, sugars from 3.0 to 5.0%, oil 3%, fiber 14% and contains some salts of metal such as iron, calcium, phosphorus, copper, zinc, boron, iodine, nickel, cobalt also contains organic acids and some vitamins such as B2 and B1. The Buckwheat was richest in protein, has a greater nutritional value from cereals proteins where like characteristics of legume proteins in terms of digestion, characterized oil compounds in seeds resistance to oxidation thus helping to easy of storage operation and conservation for a long time. (Ibraheem *et al.*, 2015) [4] Buckwheat grains are a rich source of a special type of starch with dietary lipids and contain many valuable compounds, such as proteins with a low content of  $\alpha$ -gliadin fraction antioxidative substances, trace elements and dietary fiber (Wronkowska *et al.*, 2008) [5]. Wheat is the most important stable food crop for more than one third of the world population and contributes more calories and proteins to the world diet than any other cereal crops. Wheat is considered a good source of protein, minerals, B-group vitamins and dietary fiber although the environmental conditions can affect nutritional composition of wheat grains with its essential coating of bran, vitamins and minerals; it is an excellent health-building food (Kumar *et al.*, 2011) [7].

## Materials and Methods

A raw material for preparation of khakhra was whole Garden cress seed flour, wheat flour, Buckwheat flour, Edible oil, Salt, Red chili powders, Turmeric, and Amchur.

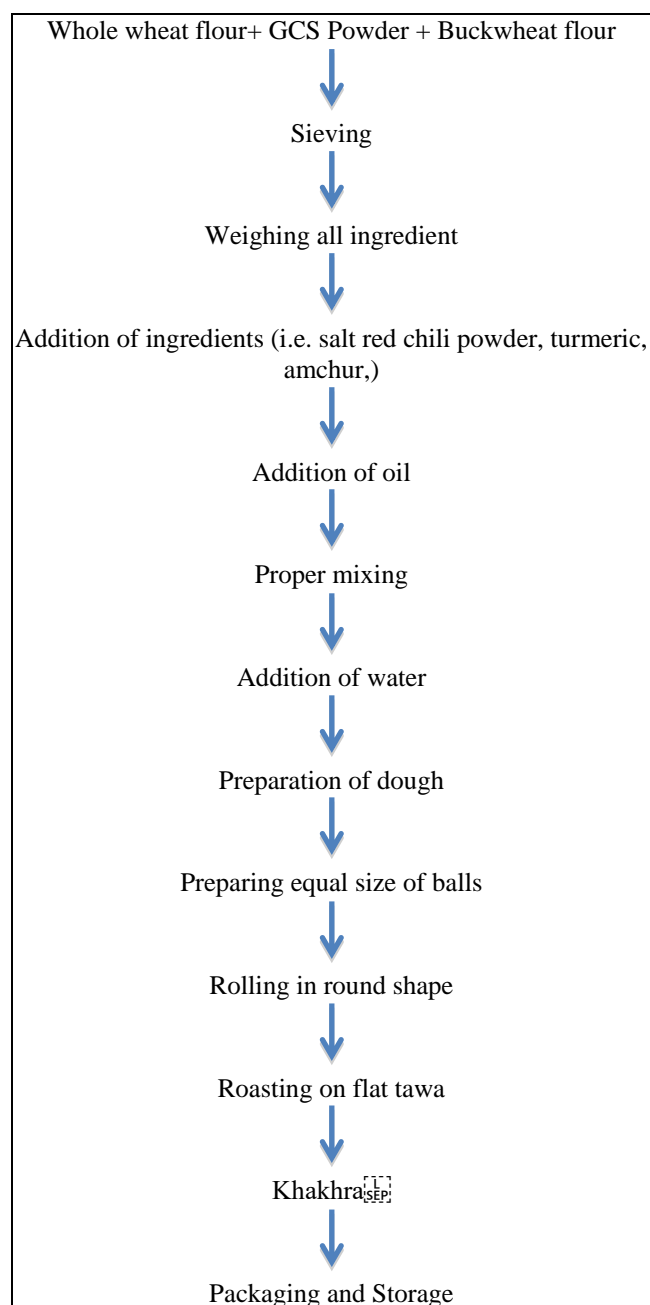
## Formulation and Standardization of Value Added Khakhra Using Different Variety and Proportion of Flour

Formulation and standardization of value added khakhra using different proportion and variety of flours viz. whole wheat flour, buckwheat flour and garden cress seeds flour was carried.

**Table 1:** Formulation and standardization of khakhra

Treatments	Whole-wheat flour (%)	Garden cress seed Flour (%)	Buckwheat flour (%)
S <sub>0</sub>	100	00	00
S <sub>1</sub>	90	05	05
S <sub>2</sub>	80	10	10
S <sub>3</sub>	70	15	15
S <sub>4</sub>	80	20	20

## Process Flowchart for preparation of Khakhra



**Fig 1:** Process flow chart for value added khakhra

## Result and Discussion

### Chemical composition of khakhra

Chemical composition generally represents the nutritional quality of product. It is necessary to observe the nutritional composition of khakhra so as to judge the nutritional quality of final product. The data pertaining to nutritional composition of khakhra is depicted in Table 2. In the present study 5 different treatment of khakhra S<sub>0</sub> (control khakhra), S<sub>1</sub> (90% whole wheat flour, 5% garden cress seed and 5% buckwheat flour containing khakhra), S<sub>2</sub> (80% whole wheat flour, 10% garden cress seed and 10% buckwheat flour containing khakhra), S<sub>3</sub> (70% whole wheat flour, 15% garden cress seed and 15% buckwheat flour containing khakhra), S<sub>4</sub> (60% whole wheat flour, 20% garden cress seed and 20% buckwheat flour containing khakhra). The result showed in Table 2.

**Table 2:** Chemical composition of khakhra

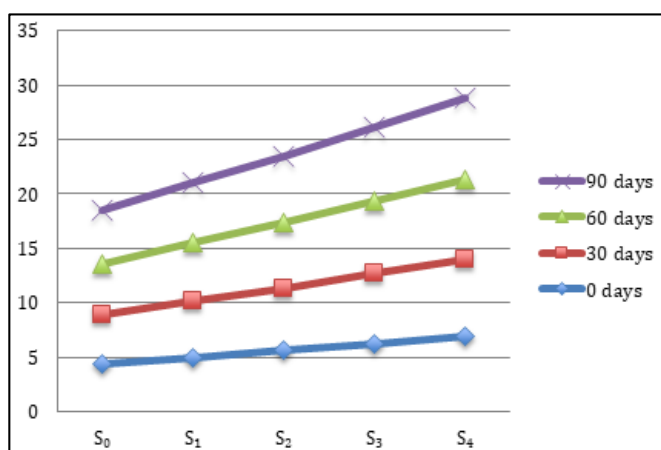
Sample	Moisture	Carbohydrate	Fat	Protein	Ash	Iron
S <sub>0</sub>	4.36	78.96	1.42	8.32	3.40	3.60
S <sub>1</sub>	5.02	72.47	1.71	10.86	4.58	8.42
S <sub>2</sub>	5.62	69.57	1.83	11.07	5.33	12.76
S <sub>3</sub>	6.28	66.93	2.12	11.31	6.41	17.83
S <sub>4</sub>	6.93	63.25	2.40	11.49	7.62	22.80

**Effect of storage on Chemical composition of khakhra****Effect of storage on percent moisture content of khakhra.**

The percent moisture score for S<sub>0</sub> was 4.36 percent on 0 day, 4.54 present after 30 days, 4.69 percent after 60 days and 4.88 percent after 90 days. Similarly for sample S<sub>1</sub>, it was 5.02 percent on 0 day, 5.22 percent after 30 days, 5.35 percent after 60 days and 5.48 percent after 90 days. Moisture content of the sample S<sub>2</sub> and S<sub>1</sub> was having significant effect because of the garden cress seed powder and buckwheat flour content. S<sub>2</sub> sample was 5.62 percent on 0 days, 5.77 percent on 30 days 5.96 percent moisture content on 60 days and 6.16 percent on 90 days during storage of khakhra. As compare to S<sub>0</sub>, S<sub>1</sub>, and S<sub>2</sub>, S<sub>3</sub>, S<sub>4</sub> sample was sharply increased with its moisture content during storage S<sub>3</sub> i.e. 6.28 percent on 0 days, 6.42 percent on 30 days, 6.62 percent on 60 days and 6.75 percent on 90 days and for S<sub>4</sub> i.e. 6.93 percent on 0 days, 7.13 percent on 30 days, 7.26 percent on 60 days, 7.53 percent on 90 days. Table 3. Increase moisture content during storage period because hygroscopic nature of whole wheat flour, garden cress seed powder and buckwheat flour also increase other factor temperature, relative humidity present in air. The result obtained agreed with result reported by Mishra and Mulshresthe (2003).

**Table 3:** Effect of different sample on moisture content of khakhra during storage (%)

Sample	0 days	30 days	60 days	90 days
S <sub>0</sub>	4.363	4.547	4.693	4.880
S <sub>1</sub>	5.023	5.220	5.357	5.480
S <sub>2</sub>	5.620	5.770	5.963	6.160
S <sub>3</sub>	6.280	6.423	6.627	6.750
S <sub>4</sub>	6.930	7.130	7.267	7.530

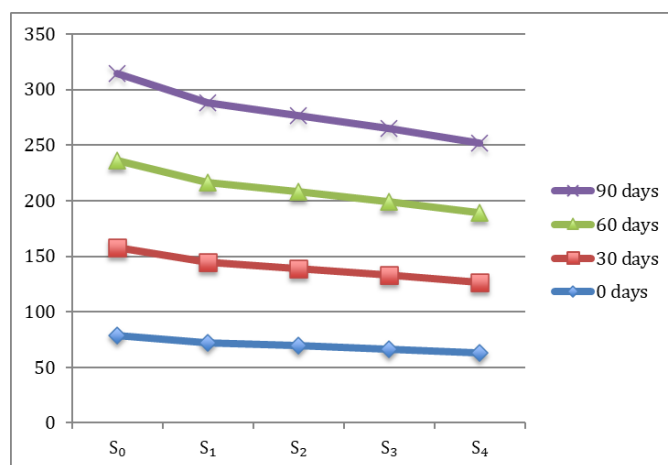
**Fig 2:** Effect of different sample on moisture content of khakhra (%)**Effect of storage on percent Carbohydrate content of khakhra (%)**

The percent Carbohydrate score for S<sub>0</sub> was 78.96 percent on 0 days, 78.66 percent after 30 days, 78.47 percent after 60 days and 78.20 percent after 90 days. S<sub>1</sub> scored 72.47 percent on 0 days, 72.37 percent after 30 days, 71.87 percent after 60 days

and 71.55 percent after 90 days. S<sub>2</sub> was 69.57 percent on 0 days, 69.26 percent after 30 days, 69.07 percent on 60 days and 68.77 percent after 90 days of percent Carbohydrate content. S<sub>3</sub> was 66.63 percent on 0 days, 66.38 percent on 30 days, 66.15 percent after 60 days and 66.82 percent Carbohydrate content on 90 days. S<sub>4</sub> was 63.25 percent on 0 days, 63.03 percent on 30 days, 62.78 percent on 60 days, and 62.48 percent on 90 days Carbohydrate content of value added khakhra. Table 4 and figure 3 shows the effect of different treatments and storage periods on percent Carbohydrate content of sample (S<sub>0</sub>, S<sub>1</sub>, S<sub>2</sub>, S<sub>3</sub>, and S<sub>4</sub>) at 30 days intervals during storage. The data clearly indicated that there was slight decrease in Carbohydrate content of sample S<sub>0</sub>, S<sub>1</sub>, S<sub>2</sub>, S<sub>3</sub>, S<sub>4</sub> the Carbohydrate content of sample S<sub>2</sub> was higher than sample S<sub>1</sub>. Therefore it can be conclude that significant effect of treatment on Carbohydrate content of S<sub>1</sub> and S<sub>2</sub> sample was observed at interval of 30 days during the storage days. Decrease the Carbohydrate content of khakhra during storage period due to the degradation of peptide bond with the help protease enzyme that spilt down molecule and occur Carbohydrate denaturation. Result was similar with the result obtained by Nasaar *et al.* (2008).

**Table 4:** Effect of storage on Carbohydrate of khakhra (%)

Sample	0 days	30 days	60 days	90 days
S <sub>0</sub>	78.960	78.663	78.470	78.200
S <sub>1</sub>	72.473	72.370	71.870	71.557
S <sub>2</sub>	69.570	69.260	69.070	68.770
S <sub>3</sub>	66.630	66.380	66.150	65.820
S <sub>4</sub>	63.250	63.037	62.780	62.480

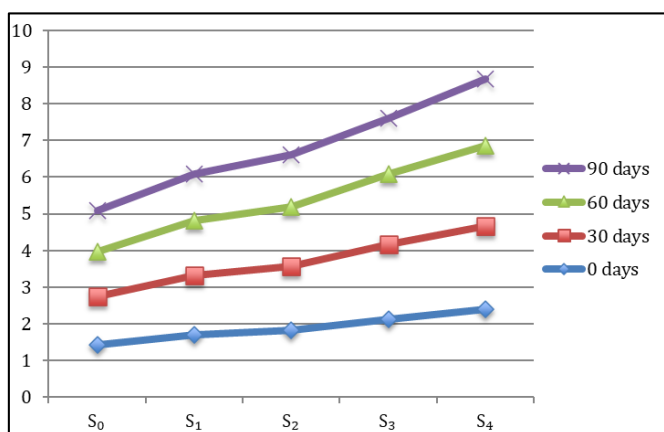
**Fig 3:** Effect of storage on Carbohydrate content of khakhra (%)**Effect of storage on fat content of khakhra (%)**

The percent fat score for S<sub>0</sub> was 1.42 percent on 0 day, 1.32 percent after 30 days, 1.22 percent after 60 days and 1.12 percent after 90 days. S<sub>1</sub> score 1.71 percent on 0 day, 1.61 percent after 30 days, 1.50 percent after 60 days and 1.35 percent after 90 days. The fat content of experimental sample was found higher than control. Table 4 and figure 3 shows the effect of different treatment and storage days on percent fat content of S<sub>0</sub>, S<sub>1</sub>, S<sub>2</sub>, S<sub>3</sub>, S<sub>4</sub>. The data clearly indicates that there was slight decrease in fat content of sample S<sub>1</sub> and S<sub>2</sub> during storage. The results in the present study showed that there was significant decrease in the fat content of value added khakhra during storage. Therefore it can be conclude that significant effect of treatment on fat content of S<sub>1</sub> and S<sub>2</sub> sample was observed at interval of 30 days during the storage days. The fat content in khakhra decreased because the development of rancidity by

the degradation of fat during storage period and the activity of lipase enzyme which split off in to aldehyde and ketone in the presence of catalyst like moisture, light and heat. The result for fat of the khakhra was similar with the result obtained by Nasaar *et al.* (2008)

**Table 4:** Effect of storage on fat content of khakhra (%)

Sample	0 days	30 days	60 days	90 days
S <sub>0</sub>	1.423	1.320	1.227	1.123
S <sub>1</sub>	1.710	1.613	1.500	1.268
S <sub>2</sub>	1.830	1.730	1.620	1.422
S <sub>3</sub>	2.127	2.030	1.927	1.524
S <sub>4</sub>	2.403	2.257	2.193	1.820



**Fig 4:** Effect of storage on fat content of khakhra (%)

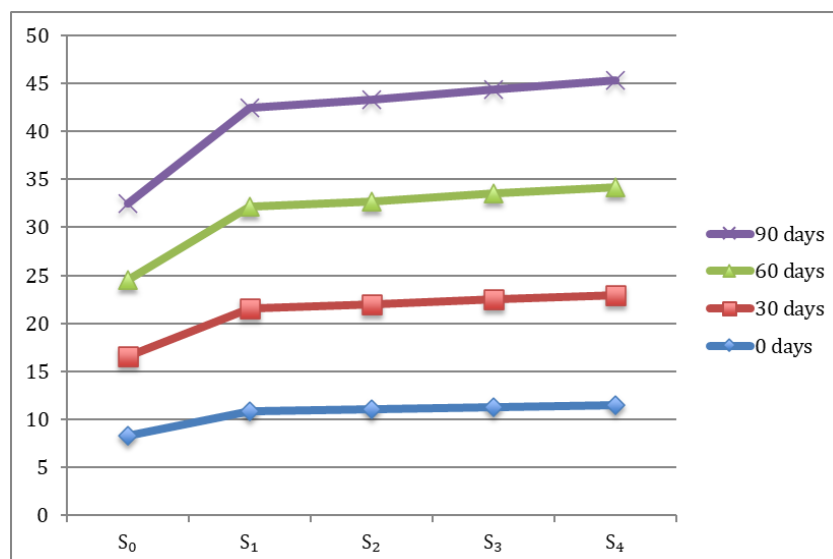
#### Effect of storage on percent protein content of khakhra (%)

The percent protein score for S<sub>0</sub> was 8.32 percent on 0 days, 8.22 percent after 30 days, 8.03 percent after 60 days and 7.87

percent after 90 days. S<sub>1</sub> scored 10.86 percent on 0 days, 10.72 percent after 30 days, 10.57 percent after 60 days and 10.31 percent after 90 days. S<sub>2</sub> was 11.07 percent on 0 days, 10.92 percent after 30 days, 10.74 percent on 60 days and 10.54 percent after 90 days of percent protein content. S<sub>3</sub> was 11.31 percent on 0 days, 11.18 percent on 30 days, 11.02 percent after 60 days and 10.83 percent protein content on 90 days. S<sub>4</sub> was 11.49 percent on 0 days, 11.41 percent on 30 days, 11.29 percent on 60 days, 11.14 percent on 90 days protein content of value added khakhra. Table 5 and figure 3 shows the effect of different treatments and storage periods on percent protein content of sample (S<sub>0</sub>, S<sub>1</sub>, S<sub>2</sub>, S<sub>3</sub>, S<sub>4</sub>) at 30 days intervals during storage. The data clearly indicated that there was slight decrease in protein content of sample S<sub>0</sub>, S<sub>1</sub>, S<sub>2</sub>, S<sub>3</sub>, S<sub>4</sub> the protein content of sample S<sub>2</sub> was higher than sample S<sub>1</sub>. Therefore it can be conclude that significant effect of treatment on protein content of T<sub>1</sub> and T<sub>2</sub> sample was observed at interval of 30 days during the storage days. Decrease the protein content of khakhra during storage period due to the degradation of peptide bond with the help protease enzyme that spilt down molecule and occur protein denaturation. Result was similar with the result obtained by Nasaar *et al.* (2008).

**Table 5:** Effect of storage on protein content of khakhra (%)

Sample	0 days	30 days	60 days	90 days
S <sub>0</sub>	8.323	8.227	8.033	7.87
S <sub>1</sub>	10.863	10.727	10.577	10.31
S <sub>2</sub>	11.077	10.92	10.74	10.543
S <sub>3</sub>	11.313	11.18	11.023	10.837
S <sub>4</sub>	11.497	11.417	11.293	11.143



**Fig 5:** Effect of storage on protein content of khakhra (%)

#### Effect of storage on percent ash content of khakhra

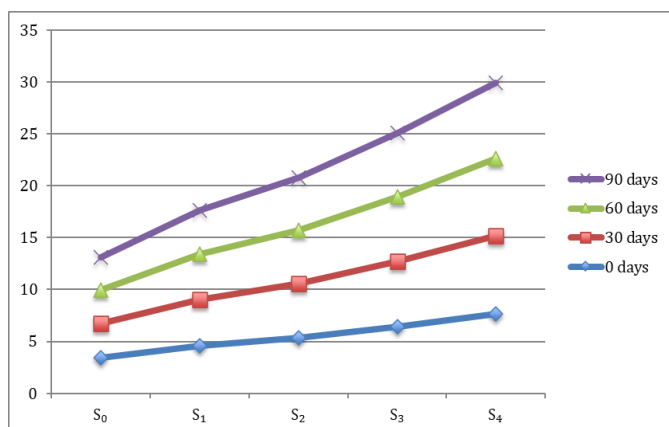
The ash content in the food stuff represents inorganic matters remaining after the organic matters have been burnt. The present ash scores for S<sub>0</sub> were 3.40 percent on 0 day, 3.32 percent after 30 days, 3.23 percent after 60 days and 3.12 percent after 90 days. Similarly for sample S<sub>1</sub> scored 4.58 percent on 0 day, 4.47 percent after 30 days, 4.35 percent after 60 days and 4.23 percent after 90 days. Sample S<sub>2</sub> scored 5.33 percent after 0 day, 5.25 percent on 30 days 5.16 after 60

days, and 5.07 percent after 90 days. Sample S<sub>3</sub> scored 6.41 percent on 0 day, 6.30 percent after 30 days, 6.22 percent after 60 days, and 6.13 percent after 90 days. Sample S<sub>4</sub> score 7.62 percent on 0 days, 7.53 percent after 30 days, 7.44 percent after 60 days and 7.35 percent after 90 days. Table 6 and figure 5 show the effect of different treatment storage days on percent ash content. The data clearly indicates that there were slight difference in ash content of sample S<sub>1</sub> and S<sub>2</sub> during storage. The decrease ash content because was due to

percentage of mineral content was decrease in value added khakhra therefore there was significance difference between sample. These are the inorganic material present in ash. Ash content indicated an estimated of the total mineral content in a given quantity of food substance. The result for ash of the khakhra was similar result obtained by Nasaar *et al.* (2008)

**Table 6:** Effect of storage on ash content of khakhra (%)

Sample	0 days	30 days	60 days	90 days
S <sub>0</sub>	3.407	3.323	3.233	3.123
S <sub>1</sub>	4.58	4.477	4.357	4.233
S <sub>2</sub>	5.337	5.25	5.16	5.073
S <sub>3</sub>	6.417	6.307	6.22	6.13
S <sub>4</sub>	7.62	7.537	7.443	7.35



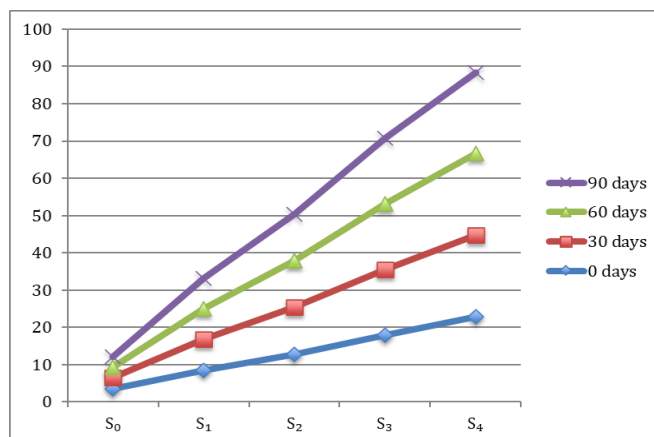
**Fig 6:** Effect of storage on ash content of khakhra

#### Effect of storage on percent iron content of khakhra

The iron content in the value added khakhra was shows the S<sub>4</sub>sample 22.08 because the incorporation rate of garden cress seed powder is high compare to the other sample. Effect of storage day on percent iron content slightly decrease the iron content in the value added khakhra. The iron content was increase with garden cress seed powder incorporation increase shows in Table 7 and fig 6 Iron content decrease during storage period because reaction in dispositive ions. The result was similar with the results obtained by Rehman *et al.* (2006) [9]

**Table 7:** Effect of storage on iron content of khakhra (%)

Sample	0 days	30 days	60 days	90 days
S <sub>0</sub>	3.6	2.963	2.86	2.773
S <sub>1</sub>	8.427	8.317	8.237	8.12
S <sub>2</sub>	12.763	12.66	12.563	12.46
S <sub>3</sub>	17.833	17.723	17.63	17.523
S <sub>4</sub>	22.8	21.97	21.863	21.763



**Fig 6:** Effect of storage on iron content of khakhra

#### Conclusion

It could be concluded that garden cress seeds are rich in iron and protein and possess better nutritional and mineral profile due to which it has potential in fortification of foodstuffs. Better taste and superior nutritive value of khakhra justifies its high consumer acceptability. After the preparation of value added khakhra it was packed in high barrier vacuum pouches. Then the physico-chemical properties were evaluated containing different various parameters. The storage study of the khakhra was carried out in the intervals of 30, 60 and 90 days. In which the effect were check during storage condition like moisture content, carbohydrate content, iron content, fat content, protein content. In that some major changes in chemical composition of khakhra.

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