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Studies on nutritional quality of garden cress seed cookies

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Abstract
The present research work was carried out to explore the possibility of utilization of underutilized but highly nutrient rich garden cress seed in cookies. Preliminary experiments were carried out to find out optimum level of garden cress seed flour with maida and garden cress seed flour with wheat flour for the preparation of quality cookies. The quality cookies were prepared from 90% maida and 10% garden cress seed flour ($CMGCF_{10}$) and 90% wheat flour and 10% garden cress seed flour ($CWGCF_{10}$). The selected treatments were packed in LDPE and PP and stored at ambient ($30 \pm 4\ ^0$ C) for 90 days to study their storage feasibility. Chemical composition of the fresh cookies prepared from 90% maida and 10% garden cress seed flour ($CMGCF_{10}$) that showed moisture content was 4.19%, protein 12.80%, crude fat 27.79%, crude fiber 1.46%, carbohydrates 66.66%, calcium 73.60 mg/100 g, iron 5.29 mg/ 100 g and phosphorus 380.88 mg/100g. and chemical composition of fresh cookies prepared from 90% wheat flour and 10% garden cress seed flour that shows moisture content was 4.16%, protein 13.12%, crude fat 26.88%, crude fiber 2.57%, carbohydrates 69.77%, calcium 51.90 mg/100 g, iron 3.29 mg/ 100 g and phosphorus 170.40 mg/100g.The sensory evaluation of cookies was carried out regularly at an interval of one month for 3 month during storage. The results on overall acceptability score of cookies are influenced by storage. The results indicated that score for overall acceptability of cookies decreased for control from 8.23 to 8.22 in LDPE and from 8.18 to 8.10 in PP as storage period get increased. For $CMGCF_{10}$ treatment score decreases from 8.26 to 8.23 in LDPE and 8.22 to 8.21 in PP was observed for 90 days of storage. The results indicated that score for overall acceptability of cookies decreased for control from 8.10 to 7.76 in LDPE and from 7.76 to 7.70 in PP as storage period get increased. For $CWGCF_{10}$ treatment score decreases from 8.12 to 8.11 in LDPE and 8.00 to 7.90 in PP was observed for 90 days of storage. Storage study of cookies showed that the cookies prepared by incorporation of garden cress seed flour, maida and wheat flour can be stored up to 3 month in LDPE with minimum losses in sensory, nutritional and textural characteristics than PP. There was no significant difference in protein, crude fiber, calcium and iron content with advancement of storage period during 3 month. The cookies were found to be acceptable up to 3 month storage at ambient temperature. The total cost of production of cookies prepared from maida and garden cress seed flour ($CMGCF_{10}$) for 1 kg was Rs. 114.49/- and total cost of production of cookies prepared from wheat flour and garden cress seed flour ($CWGCF_{10}$) for 1 kg was Rs.112.6/.

Keywords: Garden cress seed, cookies, nutritional value, organoleptic properties

Introduction
The demand for processed foods is ever increasing due to the technological, industrial and economic advances of the developing societies of the world including India. The bakery industry has been steadily growing in the country, being the largest among the processed food industries. The two major bakery industries namely bread and biscuits account for almost 82 per cent of the total bakery products. The annual production of bakery products is estimated to be more than 3.0 million tonnes (www.biscuitfederation.org). India is recognized to be the second largest producer of biscuits next only to the United States of America with annual production of which was 7.40 lakh metric tonnes in 1997-98 which has escalated to 17.14 lakh metric tonnes in 2005-2009 (Agrawal, 1990) [3]. Among the bakery products biscuits command wide popularity in rural as well as urban areas among people of all age groups (Agrawal, 1990) [3]. The production of biscuits in the country, both in the organized and unorganized sectors, is estimated to be around 11 million tones.
The cookie formula consists of refined flour, hydrogenated fat, sugar and other additives. It is well documented that most of the ingredients used in commercial cookies lack important

nutrients. The refined flour lacks in dietary fiber and micronutrients which are important health promoting components. The hydrogenated fat comprises of trans-fats which have proven to be harmful to human health. Recognizing the negative health effects of transfats many countries have banned the trans-fats in foods and have recommended zero tolerance to trans-fats in foods for infants and other vulnerable groups. Nutrition labeling to indicate the trans-fats content is made mandatory in many countries.

There is a growing awareness among the consumers regarding the constituents that affect health both positively and negatively. The number of such health conscious consumers is fast increasing and so is the health food industry. New foods with new health claims are flooding the market to meet the diverse demands of consumers. However, still there is ample scope to enhance the nutritional value of cookies both quantitatively and qualitatively using nutritious food ingredients. Garden cress seed is an important underutilized oil seed, also called as *haliv*, *aliv*, *halim*. Garden cress seed are rich in vitamins A, E and C, specially niacin, B6 and folic acid, as well as the mineral such as calcium, iron. Regular consumption of garden cress seed is very beneficial for postmenopausal women suffering from signs of cardiovascular disease, like high blood pressure and high cholesterol level.

Additionally, it can blend with most of traditional and novel foods without imparting any flavours of its own. Hence, in the present study garden cress seed was chosen to enhance the nutrient composition of cookies and biscuits in terms of dietary fiber and other nutrients

Materials and Methods

Ingredients: The major ingredients for the preparation of products were garden cress seed procured from local market. The maida was procured from local market.

Packaging material: The packaging material *viz*., LDPE and PP bags were procured from local market and used for packaging of cookies and biscuits for storage study.

Treatment details: The garden cress seed cookies were prepared by using different levels of garden cress seed flour with maida and garden cress seed with wheat flour as shown below:

Table 1: Treatment details for preparation of kodo millet cookies

Treatments	Maida (%)	Cress seed flour (%)	Treatments	Wheat flour (%)	Cress seed flour (%)
CM (T_0)	100	00	CW (T_0)	100	00
CM (T_1)	98	02	CW (T_1)	98	02
CM (T_2)	96	04	CW (T_2)	96	04
CM (T_3)	94	06	CW (T_3)	94	06
CM (T_4)	92	08	CW (T_4)	92	08
CM (T_5)	90	10	CW (T_5)	90	10
CM (T_6)	88	12	CW (T_6)	88	12
CM (T_7)	86	14	CW (T_7)	86	14
CM (T_8)	84	16	CW (T_8)	84	16
CM (T_9)	82	18	CW (T_9)	82	18
CM (T_{10})	80	20	CW(T_{10})	80	20

C = cookies, M = maida, W = wheat flour

Method

Procedure for preparation of garden cress seed flour

The dried garden cress seed were grinded in to flour and passed through sieve of 60 mesh to get uniform flour.

Preparation of garden cress seed flour cookies

The cookies were prepared using standard levels of ingredients as per the traditional creaming process.

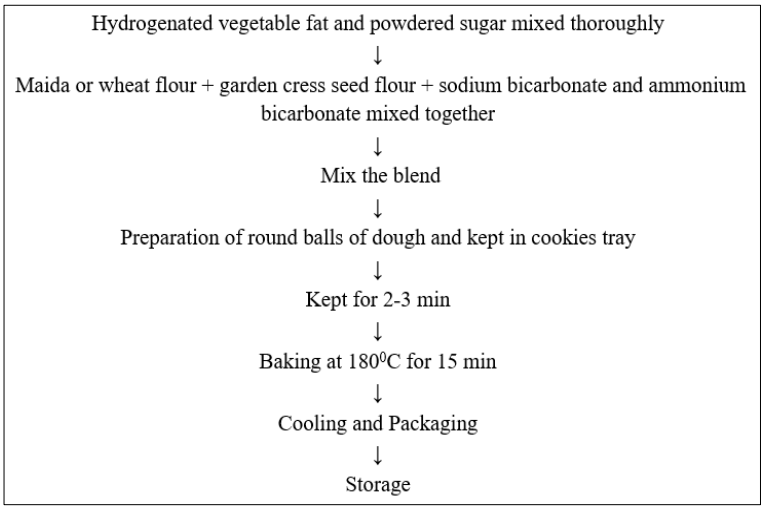

Fig 1: Flow chart for preparation of garden cress seed cookies

Physical characteristics of raw material

The raw material garden cress seed were analyzed for different physical characteristics like thousand kernel weight, bulk density and colour.

Chemical properties of raw materials, cookies

Chemical constituents like moisture, fat, protein, carbohydrate, crude fiber and minerals like calcium,

phosphorous and iron content of raw material, cookies were determined as per the standard procedure.

Physico-chemical analysis of raw material, cookies
The method described in A.O.A.C. (2000) [1, 2] for determining moisture was used. The protein content of cookies and biscuits was estimated by determining total nitrogen content using standard Micro-Kjeldhal method and fat content of the cookies and biscuits estimated by the soxhlet method A.A.C.C (2000) [1]. The crude fiber content in the products was estimated by A.A.A.C. (2000) [1]. The carbohydrate content in the selected cookies were obtained by subtracting from 100, the sum of values of moisture, protein and fat content per 100 g of the sample (Raghuramulu, *et al.*, 1993) [22]. Calcium, phosphorous and iron were analyzed using atomic absorption spectrometry (AAS). These methods give a good precision and accuracy (Ojeka and Ayodele 1995.) [20]

Packaging and storage of garden cress seed cookies
The selected treatments of garden cress seed cookies were packed in LDPE and PP and stored at ambient (30+4^{0}C) for 3 months. The samples were drawn at an interval of 1 month and evaluated for chemical and sensory quality.

Sensory evaluation of cookies
Sensory evaluation of garden cress seed cookies was carried on 9 point hedonic scale. The average scores of the ten judges for different quality characteristics *viz.* colour and appearance, flavour, texture, taste and overall acceptability were recorded.

Statistical analysis
All experiments were carried out by using Factorial Completely Randomized Design (FCRD). The results obtained in the present investigation were analyzed for the statistical significance according to the procedure given by Rangaswamy (2010) [23].

Results and Discussion

Physical characteristics of raw materials
The results obtained for physical characteristics of garden cress seed are presented below:

Table 2: Physical characteristics of raw materials

Parameter	Garden cress seed	Wheat
Colour	Reddish brown	Pale yellow
Shape	Oval	-
1000 Grain Weight (g)	1.96	222
Bulk density (kg/m^3)	1182	772.0
True density (kg/m^3)	729.74	1390.5
Porosity (%)	36.00	31.58
Angle of repose	25.17	27^0

The seed colour was raddish brown. Bulk density of seeds was found to be 1182 kg/m^3. The variations in density of garden cress seed may be due to random harvesting of garden cress seed at different maturity stages. This factor is important because it determines the capacity of storage, packaging and transport systems (Muragod, 2019) [18]. Seed colour of wheat is pale yellow. Bulk density 772.0kg/m^3.
The weight of 1000 grains is 1.96g. The shape of seed is oval. The true density of garden cress seed and wheat was to be 729.74 and 1390 kg/m^3, respectively. The porosity was 36 and 31.58%, respectively. The angles of repose for garden cress seed and wheat were found to be 25.17˚and 27˚, respectively (Chnadra kumar 2018) [10].

Chemical characters of raw materials
The results obtained for chemical characteristics of garden cress seed flour, maida and wheat are presented here:

Table 3: Chemical characters of raw materials

Chemical constituent	Maida	Wheat	Garden cress seed
Moisture (%)	13.3	12.6	4.13
Protein (%)	12.1	11.2	24.14
Fat (%)	0.9	1.7	25.85
Crude fiber (%)	0.3	1.8	8.25
Carbohydrates (%)	73.9	70.4	33.59
Calcium (mg/100g)	23.0	48.0	313.31
Phosphorus	121.0	355.0	615.40
Iron (mg/100g)	2.7	4.9	7.96

*****Each value is the average of three determinations

Chemical characters of various raw materials are comparable with findings reported by other scientist Tosco, (2004) [32]. These values are also comparable with Gopalan, *et al.*, (2006) [12]. Similar conclusions have been drawn by Bushway, *et al.*, (1981) [8], Mayela, *et al.*, (2007) [16] and Salazar, *et al.*, (2011) [26].

Sensory evaluations of fresh garden cress seed cookies
The organoleptic evaluation of cookies prepared by different combination of garden cress seed flour with maida and garden cress seed flour with wheat flour were carried out. Garden cress seed cookies were prepared and presented to panel of ten judge for assessing the quality and acceptability of product. Organoleptic evaluation of cookies was carried out using a 9 point hedonic scale of sensory characteristics such as colour, flavour texture, taste and overall acceptability. The score obtained for sensory evaluation for garden cress seed flour with maida and garden cress seed flour with wheat flour cookies are shown in Table 4 and Table 5. Garden cress seed and maid cookies (10 garden cress seed flour: 90 maida) and garden cress seed and wheat flour cookies (10 garden cress seed flour: 90 wheat flour) were found the best for preparation of garden cress seed cookies of good quality and stored at ambient temperature (30 ± 4°C) for 3 month.
Organoleptic quality parameters of a product assume pivotal role in anticipating the consumer response to the product (Rey 2006) [25]. Colour and appearance uniformity are vital components of visual quality of fresh as well as processed foods and play a major role in consumer choice (Alistair 2005) [4]. Flavour being a combination of taste, smell and mouth feel, has multifaceted impact on sensory quality of a product (Amerine, *et al.*, 1980) [5]. Overall acceptability of product is a function of various factors including colour and appearance, flavour, texture and taste. Amongst all samples for both cookies containing maida 90 per cent and garden cress seed 10 per cent and 90 per cent wheat flour and 10 per cent garden cress seed combination was found to be more acceptable. Singh *et al.*, (2000) [30] reported overall acceptability of product like cookies is a function of various factors including colour and appearance, flavour, texture and taste in the soy fortified biscuits storage. Gupta and Singh (2005) [13] reported overall acceptability of biscuits containing colour and appearance, flavour, texture and taste which gives overall acceptance by considering above all attributes.

Selection of best combination for preparation of garden cress seed fortified cookies
On the basis of organoleptic properties (colour and appearance, flavour, texture, taste and overall acceptability)

the best combination from maida and garden cress seed and wheat flour and garden cress seed flour was 90:10. For the storage study these combinations with control (100% maida) were selected and the cookies prepared from them used for further storage study. During storage study their nutritional composition, organoleptic properties and microbial quality were analysed using standard procedures.

Table 4: Sensory evaluation of fresh cookies fortified with garden cress seed flour and maida

Sample	Sensory attributes*					Rank
	Colour and appearance	Flavour	Texture	Taste	Overall Acceptability	
$CMGCF_0$	8.6	8.4	8.3	8.5	8.4	2
$CMGCF_2$	8.1	8.0	7.7	7.7	7.8	6
$CMGCF_4$	8.2	7.9	7.7	7.8	7.9	5
$CMGCF_6$	8.3	7.7	7.9	7.9	8.0	4
$CMGCF_8$	8.4	7.8	8.0	8.1	8.1	3
$CMGCF_{10}$	8.5	8.5	8.6	8.4	8.5	1
$CMGCF_{12}$	7.5	7.5	7.2	7.3	7.3	7
$CMGCF_{14}$	7.4	7.3	7.0	7.2	7.2	8
$CMGCF_{16}$	7.2	7.2	7.0	7.1	7.1	9
$CMGCF_{18}$	6.7	7.1	6.6	6.7	6.7	10
$CMGCF_{20}$	6.6	6.4	6.5	6.5	6.5	11
Mean	6.86	6.93	6.87	6.74	6.84	-
S.E.±	0.19	0.25	0.25	0.25	0.24	-
C.D at 5%	0.57	0.76	0.76	0.75	0.72	-

*Maximum score out of 9 point hedonic scale. All results are mean value of ten replications. Where as,
$CMGCF_0$ = 100% maida: 0% garden cress seed flour
$CMGCF_2$ = 98% maida: 2% garden cress seed flour
$CMGCF_4$ = 96% maida: 4% garden cress seed flour
$CMGCF_6$ = 94% maida: 6% garden cress seed flour
$CMGCF_8$ = 92% maida: 8% garden cress seed flour
$CMGCF_{10}$ = 90% maida: 10% garden cress seed flour
$CMGCF_{12}$= 88% maida: 12% garden cress seed flour
$CMGCF_{14}$ = 86% maida: 14% garden cress seed flour
$CMGCF_{16}$ = 84% maida: 16% garden cress seed flour
$CMGCF_{18}$ = 82% maida: 18% garden cress seed flour
$CMGCF_{20}$ = 80% maida: 20% garden cress seed flour

Table 5: Sensory evaluation of fresh cookies fortified with garden cress seed flour and wheat flour

Sample	Sensory attributes*					Rank
	Colour and appearance	Flavour	Texture	Taste	Overall Acceptability	
$CWGCF_0$	7.9	7.6	7.9	7.7	7.7	5
$CWGCF_2$	7.7	7.8	8.0	7.8	7.8	4
$CWGCF_4$	7.8	7.9	7.8	7.9	7.8	4
$CWGCF_6$	8.0	8.0	7.9	8.0	7.9	3
$CWGCF_8$	8.2	8.1	8.2	8.1	8.0	2
$CWGCF_{10}$	8.5	8.4	8.5	8.3	8.4	1
$CWGCF_{12}$	6.9	7.2	7.3	7.2	7.1	6
$CWGCF_{14}$	6.5	6.8	6.8	6.5	6.6	7
$CWGCF_{16}$	6.4	6.4	6.5	6.3	6.4	8
$CWGCF_{18}$	6.3	6.2	6.3	6.1	6.3	9
$CWGCF_{20}$	6.0	6.2	6.1	6.1	6.2	10
Mean	6.96.987.6	7.22	7.25	6.74	7.05	-
S.E.±	0.38	0.23	0.22	0.20	0.22	-
C.D at 5%	1.13	0.70	0.65	0.60	0.65	-

*Maximum score out of 9 point hedonic scale. All results are mean value of ten replications. Where as,
$CWGCF_0$ = 100% wheat flour: 0% garden cress seed flour
$CWGCF_2$ = 98% wheat flour: 2% garden cress seed flour
$CWGCF_4$ = 96% wheat flour: 4% garden cress seed flour
$CWGCF_6$ = 94% wheat flour: 6% garden cress seed flour
$CWGCF_8$ = 92% wheat flour: 8% garden cress seed flour
$CWGCF_{10}$ = 90% wheat flour: 10% garden cress seed flour
$CWGCF_{12}$= 88% wheat flour: 12% garden cress seed flour
$CWGCF_{14}$ = 86% wheat flour: 14% garden cress seed flour
$CWGCF_{16}$ = 84% wheat flour: 16% garden cress seed flour
$CWGCF_{18}$ = 82% wheat flour: 18% garden cress seed flour
$CWGCF_{20}$ = 80% wheat flour: 20% garden cress seed flour

Nutritional value changes in kodo millet cookies during storage

The average values of fresh cookies (100% maida) was moisture increased for treatment $CMGCF_0$ from 4.23 to 4.24 per cent in LDPE and 4.25 to 4.27 per cent in PP was observed for 90 days of the storage. The sample $CMGCF_{10}$ showed increase in the moisture content 4.25 to 4.27 per cent in LDPE and 4.28 to 4.30 per cent in PP. Protein decreased for $CMGCF_0$ treatment from 11.70 to 11.65 per cent in LDPE and from 11.68 to 11.62 per cent in PP was observed for 90 days of storage. The sample $CMGCF_{10}$ showed from 12.56 to 12.51 per cent in LDPE and from 12.53 to 12.49 per cent in PP. fat decreased for treatment $CMGCF_0$ from 25.85 to 25.76 per cent in LDPE and from 25.83 to 25.73 per cent in PP was observed for 90 days of storage. The sample $CMGCF_{10}$ showed from 27.24 to 27.19 in LDPE and from 27.23 to 27.14 in PP. the crude fiber decreased for treatment $CMGCF_0$ from 0.24 to 0.20 per cent in LDPE and from 0.23 to 0.19 per cent in PP was observed for 90 days of storage. The sample $CMGCF_{10}$ showed crude fiber content 1.42 to 1.36 per cent in LDPE and from 1.40 to 1.34 per cent in PP. carbohydrates decreased for $CMGCF_0$ from 73.64 to 73.61 per cent LDPE and from 73.60 to 73.58 per cent in PP was observed for 90 days of storage. The sample $CMGCF_{10}$ showed carbohydrate content 69.66 to 69.63% in LDPE and from 69.61 to 69.55% in PP. calcium decreased for treatment $CMGCF_0$ from 22.96 to 22.92 mg/100g in LDPE and from 22.90 to 22.88 mg/100g in PP was observed for 90 days. The sample $CMGCF_{10}$ showed from 51.87 to 51.83 mg/100g in LDPE and from 51.86 to 51.79 mg/100g in PP. iron decreased for treatment $CMGCF_0$ from 2.63 to 2.63 mg/100g in LDPE and 2.59 to 2.55 mg/100g in PP was observed for 90 days. The sample $CMGCF_{10}$ showed from 3.27 to 3.23 mg/100g in LDPE and from 3.24 to 3.19 mg/100g in PP. phosphorus decreased for treatment $CMGCF_0$ from 120.22 to 120.17 mg/100g in LDPE and 120.18 to 120.14 mg/100g in PP was observed for 90 days. The sample $CMGCF_{10}$ showed from 170.37 to 170.33 mg/100g in LDPE and from 170.34 to 170.30 mg/100g in PP. Protein, fat, crude fiber, carbohydrate, calcium, iron and phosphorus decreased in ambient temperature during storage period of 3 month. The decrease in moisture, protein, fat, carbohydrate, crude fiber, calcium and iron was more rapid in the samples stored in PP than LDPE during the storage period.

Table 6: Nutritional changes in garden cress seed flour and Maida cookies during storage at ambient temperature

Parameters	Moisture (%)	Protein (%)	Fat (%)	Crude fiber (%)	Carbohydrate (%)	Calcium (mg/100g)	Iron (mg/100g)	Phosphorus (mg/100g)
Treatment								
$CMGCF_0$	4.24	11.66	25.81	0.22	73.60	22.81	2.61	120.11
$CMGCF_{10}$	4.21	12.80	27.77	1.44	69.72	51.88	3.27	170.33
SE±	0.010	0.033	0.020	0.006	0.008	0.040	0.007	0.051
CD @ 5%	0.030	0.096	0.070	0.016	0.025	0.117	0.021	0.149
Packaging material								
P_0	4.27	12.53	27.51	1.47	69.77	51.81	3.24	170.48
P_1	4.28	12.52	27.47	1.41	69.71	51.77	3.21	170.40
SE±	0.010	0.033	0.016	0.006	0.008	0.040	0.011	0.051
CD @ 5%	0.034	0.096	NS	0.020	0.023	0.117	0.033	0.149
Storage period								
C_1	4.23	12.58	27.54	1.45	69.74	51.73	3.21	170.42
C_2	4.25	12.54	27.48	1.43	69.71	51.71	3.19	170.41
C_3	4.26	12.47	27.46	1.41	69.70	51.69	3.17	170.39
SE±	0.013	0.040	0.020	0.007	0.010	0.049	0.020	0.063
CD @ 5%	0.037	0.117	0.058	0.020	0.030	NS	0.040	0.180
Interaction								
$T_0P_0C_1$	4.23	11.70	25.85	0.24	73.64	22.96	2.63	120.22
$T_0P_0C_2$	4.24	11.69	25.78	0.23	73.63	22.93	2.63	120.19
$T_0P_0C_3$	4.24	11.65	25.76	0.20	73.61	22.92	2.61	120.17
$T_0P_1C_1$	4.25	11.68	25.83	0.23	73.60	22.90	2.59	120.18
$T_0P_1C_2$	4.26	11.66	25.76	0.21	73.59	22.89	2.58	120.16
$T_0P_1C_3$	4.27	11.62	25.73	0.19	73.58	22.88	2.55	120.14
$T_1P_0C_1$	4.25	12.56	27.24	1.42	69.66	51.87	3.27	170.37
$T_1P_0C_2$	4.26	12.55	27.23	1.39	69.64	51.85	3.25	170.35
$T_1P_0C_3$	4.27	12.51	27.19	1.36	69.63	51.83	3.23	170.33
$T_1P_1C_1$	4.28	12.53	27.23	1.40	69.61	51.86	3.24	170.34
$T_1P_1C_2$	4.29	12.51	27.21	1.38	69.58	51.81	3.21	170.31
$T_1P_1C_3$	4.30	12.49	27.14	1.34	69.55	51.79	3.19	170.30
SE±	0.026	0.080	0.040	0.014	0.021	0.098	0.027	0.125
CD @ 5%	0.070	0.234	0.120	NS	0.065	NS	0.081	0.366

*Each value represents the average of three replications.

Where, Control $CMGCF_0$ = 100% maida, $CMGCF_{10}$= 90% maida and 10% garden cress seed flour, P_0=LDPE, P_1=PP, C_1=30 days, C_2=60 days, C_3=90 days

Table 7: Nutritional changes in garden cress seed flour and wheat flour cookies during storage at ambient temperature

Parameters	Moisture (%)	Protein (%)	Fat (%)	Crude fiber (%)	Carbohydrate (%)	Calcium (mg/100g)	Iron (mg/100g)	Phosphorus (mg/100g)
Treatment								
$CWGCF_0$	4.17	12.93	26.43	1.81	63.67	43.44	4.46	320.31
$CWGCF_{10}$	4.16	13.60	26.88	2.55	66.54	73.60	5.29	380.88

SE±	0.009	0.040	0.007	0.015	0.007	0.007	0.007	0.007
CD @ 5%	0.028	0.112	0.021	0.043	0.021	0.021	0.021	0.021
Packaging material								
P_0	4.10	13.44	26.83	2.55	66.47	73.34	5.22	380.52
P_1	4.16	13.41	26.80	2.50	66.44	73.30	5.21	380.48
SE±	0.009	0.040	0.081	0.015	0.009	0.096	0.041	0.717
CD @ 5%	0.022	0.116	0.249	0.043	0.027	NS	0.123	2.093
Storage period								
C_1	4.12	13.65	26.85	2.54	66.44	73.56	5.27	380.70
C_2	4.15	13.63	26.83	2.53	66.43	73.50	5.22	380.66
C_3	4.16	13.61	26.82	2.51	66.40	73.48	5.21	380.63
SE±	0.010	0.049	0.009	0.018	0.011	1.342	0.050	0.878
CD @ 5%	0.030	0.145	0.029	0.053	0.033	NS	0.152	2.564
Interaction								
$T_0P_0C_1$	4.19	13.03	26.56	1.83	63.36	43.97	4.43	320.68
$T_0P_0C_2$	4.21	12.96	26.54	1.83	63.35	43.96	4.42	320.65
$T_0P_0C_3$	4.22	12.93	26.51	1.82	63.35	43.93	4.39	320.64
$T_0P_1C_1$	4.22	12.99	26.50	1.80	63.30	43.95	4.40	320.65
$T_0P_1C_2$	4.23	12.93	26.52	1.78	63.33	43.92	4.37	320.61
$T_0P_1C_3$	4.25	12.89	26.48	1.77	63.31	43.89	4.35	320.60
$T_1P_0C_1$	4.13	13.69	26.83	2.56	66.60	73.56	5.24	380.83
$T_1P_0C_2$	4.16	13.66	26.80	2.53	66.58	73.53	5.24	380.80
$T_1P_0C_3$	4.16	13.63	26.78	2.51	66.55	73.51	5.23	380.77
$T_1P_1C_1$	4.17	13.65	26.77	2.50	66.55	73.52	5.21	380.80
$T_1P_1C_2$	4.17	13.64	26.76	2.47	66.53	73.49	5.23	380.75
$T_1P_1C_3$	4.19	13.61	26.73	2.45	66.51	73.47	5.20	380.74
SE±	0.021	0.097	0.199	0.036	0.022	2.684	0.010	1.757
CD @ 5%	0.061	0.284	NS	0.108	0.070	NS	0.029	NS

*Each value represents the average of three replications.

Where, Control= 100% wheat flour, $WGCF_{10}$= 90% wheat flour and 10% garden cress seed flour, P_0=LDPE, P_1=PP, C_1=30 days, C_2=60 days, C_3=90 days

The average value of fresh cookies (100% wheat flour) moisture increased for treatment $CWGCF_0$ from 4.19 to 4.22 per cent in LDPE and 4.22 to 4.25 per cent in PP was observed for 90 days of the storage. The sample $CWGCF_{10}$ showed increase in the moisture content 4.13 to 4.16 per cent in LDPE and 4.17 to 4.19 per cent in PP. protein decreased for $CWGCF_0$ treatment from 13.03 to 12.93 per cent in LDPE and from 12.99 to 12.89 per cent in PP was observed for 90 days of storage. The sample $CWGCF_{10}$ showed from 13.69 to 13.63 per cent in LDPE and from 13.65 to 13.61 per cent in PP. fat decreased for treatment $CWGCF_0$ from 26.56 to 26.51 per cent in LDPE and from 26.50 to 26.48 per cent in PP was observed for 90 days of storage. The sample $CWGCF_{10}$ showed from 26.83 to 26.78 in LDPE and from 26.77 to 26.73 in PP. crude fiber decreased for treatment $CWGCF_0$ from 1.83 to 1.82 per cent in LDPE and from 1.80 to 1.77 per cent in PP was observed for 90 days of storage. The sample $CWGCF_{10}$ showed crude fibre content 2.56 to 2.51 per cent in LDPE and from 2.50 to 2.45 per cent in PP. carbohydrates decreased for $CWGCF_0$ from 63.36 to 63.35 per cent LDPE and from 63.30 to 63.31 per cent in PP was observed for 90 days of storage. The sample $CWGCF_{10}$ showed carbohydrate content 66.60 to 66.55 per cent in LDPE and from 66.55 to 66.51 per cent in PP. calcium decreased for treatment $CWGCF_0$ from 43.97 to 43.93 mg/100g in LDPE and from 43.95 to 43.89 mg/100g in PP was observed for 90 days. The sample $CWGCF_{10}$ showed from 73.56 to 73.51 mg/100g in LDPE and from 73.52 to 73.47 mg/100g in PP. the iron decreased for treatment $CWGCF_0$ from 4.43 to 4.39 mg/100g in LDPE and 4.40 to 4.35 mg/100g in PP was observed for 90 days. The sample $CWGCF_{10}$ showed from 5.24 to 5.23 mg/100g in LDPE and from 5.21 to 5.20 mg/100g in PP. phosphorus decreased for treatment $CWGCF_0$ from 320.68 to 320.64 mg/100g in LDPE and 320.65 to 320.60 mg/100g in PP was observed for 90 days. The sample $CWGCF_{10}$ showed from 380.83 to 380.77 mg/100g in LDPE and from 380.80 to 380.74 mg/100g in PP.

Mirsaeedghazi, *et al*., (2008) [17] reported that increase of protein in dough causes greater consistency of dough. The interaction including physical and chemical forces among protein molecules play key role on the rheological properties (Shiau and Yeh, 2001) [29]. The increase in protein content is acceptable for better rheological characteristics.

In cookies production, addition of fat imparts tenderness making it more palatable; assist in texture improvements. External added fat during preparation of cookies have plasticizing effects reported by Mulvancey and Cohen (1997) [19]. Sharoon, *et al*., (2014) [28] reported considerable increment the moisture content in all cookies with increasing storage duration. This increase was primarily due to packaging material (polythene bags). Sujitha and Thirumani (2014) [31] also reported increase in moisture content from 3.6-5.6% of flaxseed cookies during the storage period of 60 days. This increase was primarily due to packaging material (polythene bags). The packaging was not airtight and lack of temperature control resulted in an increase in moisture contents of cookies. Moreover, cookies absorbed moisture from surrounding atmosphere due to hygroscopic behavior of wheat flour. An increase in moisture contents of cookie samples during storage has also been reported by Leelavathi and Rao (1993) [15], Rao, *et al*., (1995) [24] Pasha, *et al*., (2002) [21], Butt, *et al*., (2004) [9] and Shariff, *et al*., (2005) [27] either due to atmosphere or packaging materials.

Conclusion

These results indicates that $CMGCF_{10}$ cookies (90 per cent maida and 10 per cent garden cress seed flour) and $CWGCF_{10}$ (90 per cent wheat flour and 10 per cent garden cress seed flour) with constant levels of other ingredients stored at ambient temperature had better acceptability till 90th day. It is

evident from all the physico-chemical properties that $CMGCF_{10}$ cookies (90 per cent maida and 10 per cent garden cress seed flour) and $CWGCF_{10}$ cookies also are the best in LDPE than PP for preparation of kodo millet cookies of good quality.

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