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Influence of Garden Cress Seed (*Lepidium sativum* L.) Bran on Quality Characteristics of Cookies

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A B S T R A C T

Garden cress (GC) is a fast-growing edible plant. Seeds, leaves and roots of GC are of economic importance, however, the crop is mainly cultivated for seeds. GC seeds have been used in traditional medicine since ancient times in India. Despite of its great medicinal value, *L. sativum* has not received the attention it deserves and has remained an under-utilized crop altogether. In present study efforts were made to separate bran from seed and its chemical composition was determined. The possibility of using it as nutraceutical food ingredient in cookies formulation was explored. Results revealed that GC seed bran contains5.32 % moisture, 13.61 % protein, 52.05 % carbohydrates, 7.29 % fat, 5.60 % ash, 16.13 %crude fiber and 74.22 % dietary fiber. Mineral composition (mg per 100 g) of GC bran such as calcium, phosphorous, iron and zinc was 623.11, 182.09, 5.96 and 2.69. 05, 10, 15 and 20 % GC seed bran were incorporated in cookies formulation on 100g flour basis. Sensory analysis revealed highest overall acceptability for sample containing 10% GC seed bran. Addition of GC seed bran showed significant increase in dietary fiber and minerals content of cookies. It was concluded that GC seed bran fortification can improve nutritional and functional characteristics of cookies.

Introduction

Garden cress (*Lepidium sativum* L.) is a member of the mustard family Cruciferae(Brassicaceae).The most commonly cultivated cress variety is garden cress or peppergrass (Kiple and Kriemhild, 2000). Garden Cress (GC) is also known as "*Halim*" in urdu, *Halive* in marathi or Chandrasur in local languages. The GC or land cress is grown worldwide and is used at the cotyledon or seedling stage as a salad component (Mabberley, 1993). In India, it is mainly cultivated in U.P., Rajasthan, Gujarat, Maharashtra, and Madhya Pradesh (The Wealth of India, 1962).

GC has been considered as an important medicinal plant since the *vedic* era. It has been used for the treatment and/or prevention of bronchial asthma, breast cancer, hypercholestermia, Osteoarthritis, inflammation, rheumatism and muscular pain, diarrhea, migraine, cough, scurvy and seminal weakness and bleeding piles.

It is rich in proteins, vitamins, minerals, especially calcium and iron. GC seeds contain 24 % fat in which 34.5 % of total fatty acids is α-linolenic acid (ALA, 18:3) (Bryan *et al.*, 2009). The seeds are rich phenolic

compounds and have high antioxidant activity compared to other cress varieties. It contains many phytochemicals with potential nutraceutical activity like glucosinolates, flavonoids, coumarins, sulphur glycosides, triterpenes, sterols and various imidazole alkaloids (Gill and Macleod, 1980; Maier *et al.,* 1998).

Despite of its high medicinal value and widespread traditional uses of GC, there are very few studies reported for its utilization in processed foods. The present investigation was initiated to explore the possibility of incorporating GC seed bran in bakery product. This study is aims to improve market value of GC by its utilization in value added products, as well as to provide highly sought after nutraceuticals in convenient form to the health conscious consumers.

Materials and Methods

Bakery ingredients

GC seeds, bakery shortening fat, wheat flour and sugar powder were purchased from a local market. The garden cress seeds were air dried, passed through a Brabender flour mill.

The separated bran was collected and used in cookies formulation.

Chemicals

Food-grade quality sodium bicarbonate and ammonium bicarbonate were used in cookies preparations. All chemicals were procured from Himedia Laboratories, Mumbai, India.

Preparation of cookies

The refined wheat flour (100 g), salt (2.5 g) and baking powder (1.0 g) were thoroughly mixed and sieved twice for uniform blend. Shortening (50 g) and ground sugar (50 g) were creamed together manually for 10 min. to get bright and fluffy mass. Finally, dry ingredient blend flour including GC seed bran incorporated flour by replacing wheat flour at 5 %, 10 % and 15 % and 20 %level was slowly added to creamed mass and mixed for 2 min. The dough was sheeted to 8 mm thickness and cut into circular shape using 42 mm diameter cutter. The cookies were then baked at 180 °C for 15 min and cooled for 10 min, wrapped in aluminium foil and packed in polyethylene bag.

Physicochemical qualities of cookies

Physical qualities of cookies

The diameter of the cookies was measured by laying four cookies edge-to-edge with the help of a scale. The same set of cookies was rotated 90°C and the diameter was re-measured. Average values of these cookies are reported in cm. The thickness (T) of cookies was measured by stacking four cookies on top of one another and taking their average in mm. The spread ratio was calculated by dividing the diameter (D) by thickness (T) Rangrej *et al.,* (2015).

Proximate and minerals composition of maida, GC seed bran and prepared cookies

The moisture, fat, protein, crude fiber, dietary fiber and ash content of the maida, GC seed bran and prepared cookies were determined according to the AOAC official methods (AOAC, 1990). Carbohydrates were calculated by difference method.

Sensory qualities of cookies

The cookies were evaluated for sensory attributes like colour, flavour, texture, taste and overall acceptability by a panel of 10 semi-trained judges, using a 9 point Hedonic scale system (Amerine *et al.,* 1965).

Statistical analysis

The data obtained was analyzed statistically using Completely Randomized Design (CRD) used to test the significance of results (Panse and Sukhatme, 1985). The analysis of variance was performed at significance of $p<0.05$ level, S.E. and C.D. at 5 % level was mentioned wherever required.

Results and Discussion

Proximate composition of wheat flour and garden cress seed bran

The whole cress seed had 76.12 per cent endosperm and 23.88 per cent bran (Table 1). The moisture, carbohydrate, protein, fat, crude fiber, dietary fiber and ash content of wheat flour was 13.89, 71.02, 12.22, 1.76, 0.67, 0.36 and 1.11 per cent, respectively whereas the proximate composition of garden cress seed bran shows 5.32 per cent moisture, 52.05 per cent carbohydrate, 13.61 per cent protein, 7.29 per cent fat, 16.13 per cent crude fiber, 74.22 per cent dietary fiber and 5.60 per cent ash.

Gokavi *et al.,* (2004) reported that GC seed had 72 per cent endosperm and 28 per cent bran. The whole meal, endosperm and bran of garden cress seed had 4.14, 2.28 and 4.27 per cent moisture, 22.5, 27.7 and 12.6 per cent protein, 27.5, 33.1 and 6 per cent fat, 34.24, 28.45 and 50.31 per cent carbohydrates, 7.01, 4.00 and 14.29 per cent crude fiber, 30, 13.6 and 75 per cent dietary fiber and 4.65, 4.06 and 6.19 per cent ash, respectively.

Mineral content of wheat flour and garden cress seed bran

Calcium content of maida was 38.22 mg/100g (Table 2). It contained 119.13 mg/100g phosphorus. The iron and zinc content of maida was 4.12 and 0.82 mg/100g. Similar results were observed by Desai *et al.,* (2010); Kulkarni *et al.,* (2012) and Singh *et al.,* (2005).

GC seed bran contains 623.11 mg of calcium, 182.09 mg of phosphorous, 5.96 mg of iron and 2.69 mg / 100 g zinc. Gokavi *et al.,* (2004) reported the whole meal, endosperm and bran of GC seed had 296.60, 210.51 and 556.32 mg calcium, 514.59, 652.81 and 209.92 mg phosphorous, 7.62, 8.31 and 6.61 mg iron and 5.05, 5.31 and 2.98 mg zinc, respectively.

Influence of garden cress seed branon physical quality of cookies

In order to understand the significance of GC seed bran addition on physical properties such as weight, diameter, thickness, spread ratio and spread factor were determined. The treatment GCB_{20} obtained highest weight (10.19 g) after baking and lowest (10.02 g) in treatment GCB_0 (Table 3). The thickness for treatment GCB_0 (13.73 mm) was highest among all other treatments. The treatment GCB_5 exhibited lowest thickness of cookies (10.28 mm). The treatment GCB_5 was statistically superior in spread ratio (4.47) of cookies after baking over all other treatments. Treatment GCB_5 shows highest spread factor (133.43) after baking. The changes in diameter and thickness are reflected in spread ratio which decreased consistently and adversely affecting the thickness and diameter and thus, spread ratio of the supplemented biscuits (Eissa *et al.,* 2007).

Reduced spread ratio of cookie was attributed to the fact that composite flours apparently form aggregates with increased numbers of hydrophilic sites available for competing for the limited free water in cookie dough (Hooda and Jood, 2005). Rapid partitioning of free water of these hydrophilic sites occurs during dough mixing and increases dough viscosity, thereby limiting cookie spread and top grain formation during baking.

Influence of garden cress seed bran on sensory quality of cookies

The changes in the sensory characteristics like colour and appearance, texture, flavour, taste, and overall acceptability were statistically significant among all the treatments (Table 4). The cookies sample prepared with the treatment GCB_{10} was statistically superior for overall acceptability over all other treatments.

The cookies prepared with treatment GCB_{20} obtained lowest score for overall acceptability. The score was decreased for colour and appearance from 8.12 in control (GCB_0) to 6.12 GCB_{20}, texture 8.00 in control to 6.62 GCB_{20}, flavour 7.87 in control to 6.50 GCB_{20}, taste 8.0 in control to 6.00 GCB_{20}, respectively. Overall acceptability of garden cress seed bran incorporated cookies was higher (7.93) in GCB_{10} than control (7.87).The colour score of cookies obtained with use of garden cress seed bran was less acceptable as compared to control. This may be due to brownish colour of the bran and at 20% level of bran, the darker colour was prevalent.It was revealed that, 10 % addition of bran helped in improved acceptability of cookies. The soft texture and pleasant flavour in cookies was achieved with addition of 10% bran. Cookies containing up to 20 % wheat bran were acceptable to a consumer panel (Vratanina and Zabik, 1978) and 30% use of oat bran (Sudha *et al.*, 2007).

Table.1 Proximate composition of maida and garden cress seed bran

Sr. No.	Parameter (%)	Maida	Garden cress seed Bran
1	Moisture	13.89	5.32
2	Protein	12.22	13.61
3	Fat	1.76	7.29
4	Carbohydrate	71.02	52.05
5	Crude fibre	0.67	16.13
5	Dietary fiber	0.36	74.22
6	Ash	1.11	5.60

* Each value represents the average of five determinations

Table.2 Minerals composition of different fractions of garden cress seed

Sr. No.	Parameter (mg per 100 g)	Maida	Garden cress seed Bran
1	Calcium	38.22	623.11
2	Phosphorous	119.13	182.09
3	Iron	4.12	5.96
4	Zinc	0.82	2.69

Table.3 Influence of garden cress seed bran on physical quality of cookies

Attributes / Treatments	Weight (g)	Diameter (mm)	Thickness (mm)	Spread ratio	Spread factor (%)
Control	10.02	46.11	13.73	3.35	100
GCB_5	10.11	46.03	10.28	4.47	133.43
GCB_{10}	10.14	45.33	11.05	4.10	122.38
GCB_{15}	10.19	45.11	12.58	3.58	106.86
GCB_{20}	10.25	44.47	13.48	3.29	98.20
SE ±	0.016	0.013	0.011	0.039	0.19
CD at 5%	0.05	0.03	0.03	0.11	0.58

Where, GCB_5=5% bran, GCB_{10}=10% bran, GCB_{15}=15% bran and GCB_{20}=20% bran

Table.4 Influence of garden cress seed bran on sensory quality of cookies

Attributes / Treatments	Colour	Texture	Flavour	Taste	Overall Acceptability
Control	8.12	8.00	7.87	8.00	7.87
GCB_5	7.37	7.5	7.31	7.31	7.56
GCB_{10}	**7.25**	**7.93**	**7.75**	**7.87**	**7.93**
GCB_{15}	6.87	7.00	7.12	6.62	6.75
GCB_{20}	6.12	6.62	6.5	6.00	6.12
SE ±	0.07	0.04	0.02	0.05	0.008
CD at 5%	0.022	0.12	0.07	0.15	0.02

Where, GCB_5=5% bran, GCB_{10}=10% bran, GCB_{15}=15% bran and GCB_{20}=20% bran

Table.5 Influence of garden cress seed bran on proximate composition of cookies

Treatments	Moisture (%)	Protein (%)	Carbohydrate (%)	Fat (%)	Crude fiber (%)	Dietary fiber (%)	Ash (%)
Control	**4.80**	**7.24**	**60.71**	**25.89**	**0.62**	**0.30**	**0.74**
GCB_5	4.58	7.55	60.84	25.05	1.19	3.96	0.79
GCB_{10}	**4.46**	**7.87**	**60.82**	**24.12**	**1.89**	**7.26**	**0.84**
GCB_{15}	4.30	8.19	60.82	23.18	2.62	10.92	0.89
GCB_{20}	4.24	8.49	60.87	22.25	3.49	14.89	0.96
SE±	0.037	0.008	0.013	0.016	0.005	0.017	0.012
CD at 5%	0.11	0.024	0.039	0.050	0.01	0.05	0.037

Where, GCB_5=5% bran, GCB_{10}=10% bran, GCB_{15}=15% bran and GCB_{20}=20% bran

Table.6 Influence of garden cress seed bran on micronutrient composition of cookies

Treatments	Calcium (mg/100g)	Phosphorous (mg/100g)	Iron (mg/100g)	Zinc (mg/100g)
Control	**26.12**	**111.03**	**2.89**	**0.77**
GCB_5	43.12	113.57	3.04	0.86
GCB_{10}	**69.56**	**116.13**	**3.19**	**0.92**
GCB_{15}	92.14	119.68	3.34	0.97
GCB_{20}	119.56	124.24	3.50	1.04
SE ±	0.013	0.013	0.048	0.012
CD at 5%	0.039	0.041	0.14	0.037

Where, GCB_5=5% bran, GCB_{10}=10% bran, GCB_{15}=15% bran and GCB_{20}=20% bran

Table.7 Textural characteristics of garden cress bran cookies

Sr. No.	Treatments	Crushing force (N)	Cutting force (N)	Penetration force (N)
1	Control	50.51	35.28	13.82
2	GCB_5	53.54	46.19	16.12
3	GCB_{10}	83.55	50.18	17.26
4	GCB_{15}	122.02	55.36	23.73
5	GCB_{20}	137.74	59.58	27.21
6	SE ±	2.71	0.041	0.10
7	CD at 5%	8.18	0.12	0.31

Where, GCB_5=5% bran, GCB_{10}=10% bran, GCB_{15}=15% bran and GCB_{20}=20% bran

Influence of garden cress seed bran on nutritional quality of cookies

Proximate composition of garden cress seed bran fortified cookies

The proximate composition of cookies is presented in table 5. The cookies prepared with treatment GCB_0 (4.80 %) was statistically superior in moisture content over other treatments followed by treatments GCB_5 (4.58 %), GCB_{10} (4.46 %), GCB_{15} (4.30 %) and GCB_{20} (4.24 %). The cookies with treatment GCB_0 recorded highest fat percentage (25.89 %) whereas lowest (22.25 %) fat was reported in treatment GCB_{20}. The addition of bran slightly decreased the fat content of cookies. In cookies production, addition of fat imparts tenderness making it more palatable; assist in texture improvement. External added fat during preparation of cookies have plasticizing effects reported (Mulvancey and Cohen, 1997). Protein content of cookies in treatment GCB_{20} was highest (8.49 %) with lowest protein content in treatment GCB_0 (7.24 %). Treatment GCB_{20} (60.87 %) was statistical superior in carbohydrates over all other treatments. Carbohydrates content of cookies with treatment GCB_{20} was highest (60.87 %) and lowest in control treatment GCB_0 (60.71 %). The ash content of cookies in treatment $GC2_{10}$ was highest (0.96 %) with lowest value in treatment GCB_0 (0.74 %).

The crude fiber and dietary fiber in cookies was 0.62 to 3.49 per cent and 0.30 to 14.89 per cent, respectively. Comparable results were reported by Nagarajaiah and Prakash, (2015) for dehydrated carrot pomace cookies. The use of oat bran, wheat bran, and rice bran as a source of dietary fiber content in bread and other bakery products was reported by Laurikainen *et al.,* (1998) and Sidhu *et al.,* (1999).

Micronutrient composition of garden cress seed bran fortified cookies

The prepared cookies with addition of different levels of garden cress seed bran were evaluated for calcium, phosphorous, iron, and zinc. The calcium, phosphorous, iron and zinc (mg/ 100 g) of cookies ranged from 26.12 (GCB_0) to 119.56 (GCB_{20}) (Table 6), 111.03 (GCB_0) to 124.24 (GCB_{20}), 2.89 (GCB_0) to 3.50 (GCB_{20}) and 0.77 (GCB_0) to 1.04 (GCB_{20}). The results showed that the calcium content of cookies was linearly increased as concentration of bran increases. There was significant variability of calcium, phosphorous, iron, and zinc content of prepared cookies than control sample. Clarke *et al.,* (2003) reported pineapple pomace and wheat bran fortified biscuits also contains higher amount of calcium, phosphorus and iron Likewise Kuldip *et al.,* (2014) also found the similar result.

Influence of garden cress seed bran on textural quality of cookies

Texture is very important characteristic which makes a significant contribution to the overall acceptability of the food products. It is one of the three main acceptability factors used by consumers to evaluate food, the other two being appearance and flavour (Bourne, 2002). The average peak force is the measure of cookies hardness. Hardness was measured in terms of force required to crush the cookie or the force required to cut the cookie or the force required to penetrate the cookie. It was observed that there was significant increase in hardness of cookies with increased addition of garden cress seed bran.

The crushing force, cutting force and penetration force of garden cress seed bran incorporated cookies ranged from 50.51 (Control) to 137.74 N (GCB_{20}), 35.28 (Control) to 59.58 N (GCB_{20}) and 13.82 (Control) to 27.21 N (GCB_{20}), respectively (Table 7). The crushing force, cutting force and penetration force increased with incremental addition of garden cress seed bran in cookies. Hoseney and Rogers (1994) reported that hardness of cookies was caused by the interaction of proteins and starch by hydrogen bonding. Similar results were observed by Singh *et al.,* (1996); Barnwal *et al.,* (2013) and Rajiv *et al.,* (2012).

The garden cress seed bran being a good source dietary fiber and minerals can be explored as a novel functional food ingredient in bakery products where refined wheat flour is used.

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