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Formulation and nutritional quality evaluation of *namakpare* supplemented with garden cress (*Lepidium sativum* L.) seeds

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Abstract

Garden cress (*Lepidium sativum* L.) is a small perennial edible plant that produces seeds which are very small in size, smooth in texture, oval in shape and reddish brown in colour. The seeds are loaded with macro and micro nutrients and also possess health enhancing properties. Garden cress seeds have galactagogue properties which promote lactation and prevent postnatal complications. Considering these properties, a savory snack i.e. *namakpar*e *(matar)* was formulated for lactating mothers using variable proportions of germinated gardencress powder. Results revealed a significant increase in the nutritional attributes of germinated garden cress seed incorporated *namakpare*. There was significant and proportionate increase in macronutrients of *namakpare* with increase in levels of supplementation. 20 per cent incorporated *namakpare* had higher amount of ash, fat, fiber, and protein (3.54, 23.20, 2.20, and 11.45 per cent) respectively as compared to control and 5, 10, 15 per cent incorporated *namakpare.* Iron, calcium and phosphorus content had a surge of value from 1.91, 21.59 and 119.25 mg in control (0 per cent supplementation) to 20.85, 91.79 and 239.86 mg in 20 percent supplementation.

Key words: Garden cress seeds, germination, namakpare, proximate composition, minerals

Garden cress is a fast-growing, perennial edible plant widely cultivated in hot temperate climates throughout the world for various culinary and medicinal uses (Shabbir *et al.* 2018). In India, it is grown mainly in the States of Gujarat, Rajasthan, Madhya Pradesh, Uttar Pradesh and Maharashtra (Prajapati and Dave 2018; Vaishnavi *et al*.2020)

The seeds are high in calories (454 kcal) having 25 gm protein, 24 gm fat, 3 gm dietary fibre and 33gm of carbohydrates per 100gm of seeds and also has significant amount of minerals viz., 100 mg iron, 377 mg of calcium, 430 mg magnesium and 723 mg of phosphorous and sufficient amount of vitamins, mainly niacin (14.3 mg), riboflavin (0.61 mg) and thiamine (0.59 mg) per 100g seeds (Gopalan *et al.* 2010; Chaudhary and Gupta, 2017).

Garden cress seeds contain highest iron in plant kingdom i.e. 100 mg iron per 100 g of seeds with better bioavailability and therefore also known as *raktabija* in Sanskrit (Sarkar *et al.* 2014). Garden cress is botanically related to watercress and mustard, so shares their peppery, tangy flavor and aroma. The bitterness and pungency of garden cress seeds is due to the presence of ample amounts of glucosinolates, alkaloids and tannins that greatly reduces its acceptability to be incorporated in food products (Divanji *et al.* 2012).

The seeds are beneficial for nursing mothers as they possess galactogogue properties and prevent postnatal complications (Prajapati and Dave, 2018). A breastfeeding mother needs to consume an adequate balanced diet having all the nutrients along with minerals so gardencress in form of various recipes is given after delivery in various regions of the country for postnatal care. Being a rich source of nutrients like protein, iron and folic acid, a wide range of phytochemicals with therapeutic benefits, lactogenic properties, an attempt was made in the present study to utilize and explore the possibility of garden cress seeds as a functional food ingredient for development

of convenience ready to eat, nutrient-dense salty snack i.e. *namakpare (matar)* for lactating mothers.

Materials and Methods

Treatment of garden cress seeds

Garden cress seeds procured from local market were cleaned manually for removing adhering dirt, dust and foreign particles. To reduce the peppery and tangy taste of garden cress seeds and enhancing its palatability and acceptability attributes, germination treatment was given to selected samples. Garden cress seeds were spread on a damp muslin cloth and were kept at room temperature (32°- 35 °C). Regular sprinkling of water was carried out to keep the seeds moist. Seeds took 48 hrs for germination (about 1 – 1.5 cm long). Germinated seeds were then dried in tray drier at 55 °C for 12 hrs. After giving the above treatment, the processed seeds as well as raw garden cress seeds were ground into a fine powder as shown in Figure 1 to be incorporated in *namakpare* formulations.

Standardization and development of blended formulations

Garden cress supplemented *namakpare (matar)* were standardized and developed in the laboratory using modified method of Rana and Kaur (2016). Germinated garden cress seed powder was incorporated in varying proportions of 5%, 10%, 15% and 20% to develop and assess the best acceptability level in *namakpare*. In addition, one control recipe was also developed for comparison purpose. So, a total of four variants in addition to control recipe were formulated as shown in Figure 2. The formulations of *namakpare* were coded as: N_1 for control, N_2 for 5% incorporated *namakpare*, N_3 for 10% incorporated *namakpare*, N_4 for 15% incorporated *namakpare* and N_5 for 20% incorporated *namakpare.* The basic recipe and procedure of making this savoury snack has been documented in Flowsheet 1.

Nutritional composition

Macronutrients viz. ash, crude protein, crude fat, crude fibre were estimated alongwith moisture content by standard methods as described by AOAC (2010). Total carbohydrates content was determined by difference method.

The organic matter present in different formulation of *namakpare* was wet digested with diacid mixture. The digested samples for minerals were analysed for determination of calcium and iron using atomic absorption spectrophotometer (Model: Perkin–Elmer 3100) while phosphorous was measured spectrophotometrically (Singh *et al.* 2005).

Statistical analysis

All the analysis work was carried out in triplicate so as to reduce the experimental error and subjected to statistical analysis for one way analysis of variance

Fig. 1 Germinated garden cress seeds and powder

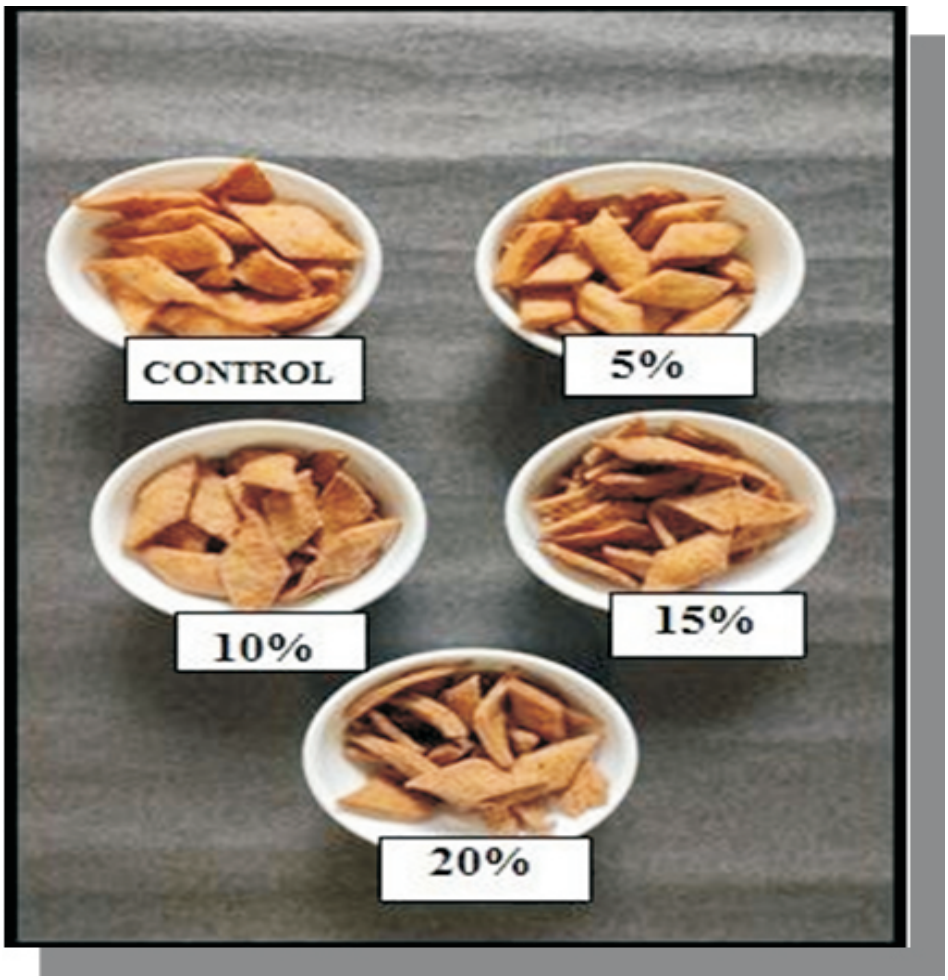

Fig. 2 Developed *namakpare* of germinated garden cress seeds

Sift refined wheat flour (100g)

⇩

Add refined oil (10ml) and rub thoroughly

⇩

Add salt (2g) carom seeds (3g) and mix properly

⇩

Add water (35ml) and knead smooth, pliable dough

⇩

Wrap dough in a damp cloth and keep aside to rest for 10-15 minutes

⇩

Divide the dough into equal portions and roll each portion into a thin circle

⇩

Cut the circle in diamond shape

⇩

Heat oil and deep-fry the *namakpare* in medium flame till golden brown

⇩

Cool and store the fried *namakpare* in sealed aluminium foil-lined kraft paper bags

Flowsheet 1. Preparation of *namakpare*

(ANOVA) in a completely randomized design at 5 per cent level of probability using "OPSTAT" statistical software (Sheoran *et al.* 1998). The values obtained have been reported as mean and standard deviation. Per cent deviation i.e. the effect of incorporation of varying proportion of germinated garden cress seed powder on the nutritional and mineral composition of *namakpar*e was also assessed and reported in tables.

Results and Discussion

The effect of adding variable proportions of germinated garden cress powder in *namakpare* was analysed on proximate composition and represented in Table 1. N_1, N_2, N_3, N_4 and N_5 *namakpare* retained 6.25, 6.29, 6.43, 6.54 and 6.90 per cent moisture content respectively. Non-significant difference was calculated when N_1 (control) was compared with N_2 (5% supplementation) while the difference was significant when N_1 was compared with N_3, N_4 and N_5 formulations. Addition of 5, 10, 15 and 20 per cent supplementation led to a percent rise of 0.64, 2.88, 4.64 and 10.40 respectively.

A scrutiny of the table depicts that the total ash content of *namakpare* increased with the addition of germinated garden cress seeds powder in the prepared formulations. Ash content ranged from 0.75 to 3.54. The lowest ash content of 0.75 per cent was present in control *namakpare* which only contained 100 g refined wheat flour and no cress supplementation. Addition of 5, 10, 15 and 20 per cent level of garden cress powder in the recipes increased the ash content to 1.48, 2.12, 2.85 and 3.54 with per cent increase of 97.33, 182.66, 280 and 372 respectively. When analysed statistically, a significant difference was observed when N_1 (control) was compared with N_3, N_4 and N_5 whereas non-significant difference was observed when N_1 (control) was compared with N_2 (5% incorporated) *namakpare*.

The fat content increased significantly ranging from 18.66 per cent (0 % supplementation) to 23.20 per cent (20 % supplementation) with per cent increment of 24.33. The basic ingredients and cooking time for all the formulations was almost the same but the presence of high-fat content of 25 per cent in cress seeds increased the crude fat content of all the formulations. So, when 5, 10, 15 per cent germinated garden cress powder was added in the recipe, the percentage of crude fat content increased to 19.40, 20.51 and 21.97 influencing per cent increment of 3.96, 9.91 and 17.73, respectively.

A great upsurge of crude fibre content in *namakpare* formulations was observed when germinated cress powder was added in the recipes. 5, 10, 15 and 20 per cent of cress addition increased the crude fibre content from 0.27 to 0.82, 1.45, 1.8 5 and 2.20 with a high per cent rise of 203.70, 437.03, 585.18 and 714.81, respectively. So, a significant difference was calculated at 5 per cent level of probability. Garden cress formulations differed significantly with each other as well as with the control recipe when evaluated statistically.

The data in Table 1 revealed that crude protein

Table 1. Proximate composition of *namakpare* (% DW basis)

Proximate Parameters	Level of incorporation					Mean	C.D ($p \leq 0.05$)
	N_1	N_2	N_3	N_4	N_5		
Moisture	6.25±0.01	6.29±0.04 (+0.64)	6.43±0.02 (+2.88)	6.54±0.07 (+4.64)	6.90±0.04 (+ 10.40)	6.48±0.02	0.082
Ash	0.75±0.04	1.48±0.03 (+97.33)	2.12±9.02 (+182.66)	2.85±0.03 (+280.00)	3.54±0.03 (+372.00)	2.14±0.04	0.135
Crude fat	18.66±0.13	19.40±0.08 (+3.96)	20.51±0.03 (+9.91)	21.97±0.02 (+17.73)	23.20±0.06 (+24.33)	20.74±0.09	0.291
Crude fibre	0.27±0.04	0.82±0.03 (+ 203.70)	1.45±0.02 (+437.03)	1.85±0.03 (+585.18)	2.20±0.02 (+714.81)	1.31±0.05	0.270
Crude protein	8.32±0.10	9.13±0.02 (+9.73)	9.97±0.04 (+19.83)	10.45±0.08 (+ 25.60)	11.45±0.06 (+37.62)	9.86±0.04	0.111
Total carbohydrate	65.73±0.03	62.79±0.02 (-4.55)	58.83±0.01 (-10.49)	56.31±0.02 (-14.33)	52.37±0.03 (-20.32)	59.20±0.24	0.766

Data are expressed as the mean ± standard deviation. Data in parenthesis show per cent deviation

content of supplemented *namakpare* increased with the increase in the germinated garden cress seeds powder concentration in the prepared product when compared with control *namakpare*. The protein content ranged from 8.32 per cent (control) to 11.45 per cent (20 per cent supplementation). N_2 (5 per cent supplementation) had a crude protein content of 9.13 % influencing per cent increment of 9.73. N_3 and N_4 supplemented *namakpare* had 9.97 and 10.45 per cent protein leading to positive per cent increment of 19.83 and 25.60 and thus had a significant difference when compared with control. The highest protein content was in *namakpare* incorporated with highest level of incorporation with per cent increment of 37.62. As discussed earlier, cress seeds are an excellent source of protein and fat having an almost similar value of 25 per cent. So, an additional increment of cress added to the protein content of *namakpare.* Non-significant *difference* ($P \leq 0.05$) was observed when crude protein content of N_1 (control) *was* compared with N_2 (5per cent supplementation) *namakpare* and significant difference was observed when N_1 was compared with N_3, N_4, N_5 *namakpare*.

Total carbohydrates content decreased with an increase in content of germinated garden cress seeds powder in the *namakpare.* So, highest total carbohydrates of 65.73 per cent were present in control recipe that decreased to 62.79, 58.83, 56.31 and 52.37 per cent in N_2, N_3, N_4 and N_5 with a down percentage of 4.55, 10.49, 14.33 and 20.32 respectively. Non-significant difference in the carbohydrate content was observed when supplemented formulations were compared with each other and with control *namakpare*.

So, highest nutritive value was assessed for treatment N_5, i.e. *namakpare* having 20 per cent addition of germinated cress powder. Various studies done on similar aspects also reported a hike in nutritive value proportionate to addition of cress powder. Singh and Srivastava (2012) prepared iron-rich *namakpare* mixes which were nutritious having crude protein ranging from 9.34-23.6 per cent, crude fibre 0.30-3.51 per cent, crude fat 0.85 -4.57 per cent, total ash 0.60 - 4.51 per cent and carbohydrates 54.90-59.79 per cent. Rana and Kaur (2016) studied the effect of garden cress seeds utilization in biscuits, *namakpara* and *laddoo* in ratios of 5, 10, and 15 per cent. The developed supplemented products contained significantly higher moisture, protein, fibre content compared to those of control.

Just like all other nutrients, minerals are also very important for human body. Body use minerals to perform many different functions like iron is a part of haemoglobin molecule found in red blood cells that carry oxygen in the body and are also needed for energy metabolism. Calcium is important for healthy bones and teeth, helps in muscle relaxing and contracting, regulates blood pressure and play important role in nerve functioning. Phosphorus is important for healthy bones, teeth and maintains acid-base balance.

The effect of germinated garden cress powder on the mineral profile of the value-added product was analysed and the results calculated have been reported as mg/100 g dry weight basis in the Table 2. Control *namakpare* contained minimum amount of iron i.e. 1.91 mg iron per 100g portion. Addition of cress powder significantly increased the iron content of

Table 2. Mineral profile of *namakpare* formulations (mg/100 g on dry matter basis)

Parameters	Level of incorporation					Mean	CD ($p \leq 0.05$)
	N_1	N_2	N_3	N_4	N_5		
Iron	1.91±0.01	6.93±0.03 (+262.82)	11.40±0.29 (+496.85)	15.81±0.40 (+727.74)	20.85±0.18 (+991.62)	11.38±0.24	0.768
Calcium	21.59±0.30	38.62±0.22 (+78.87)	56.19±0.52 (+160.25)	75.53±0.23 (+249.83)	91.79±0.06 (+325.15)	56.74±0.30	0.982
Phosphorous	119.25±0.20	149.43±0.33 (+25.30)	179.96±0.12 (+50.90)	210.31±0.31 (+76.36)	239.86±0.40 (+101.14)	179.76±0.29	0.941

Data are expressed as the mean ± standard deviation. Data in parenthesis show per cent deviation.

namakpare formulations. Levels of 5, 10, 15 and 20 per cent raised values of this mineral to 6.93, 11.40, 15.81and 20.85 mg influencing a significant per cent increase of 262.82, 496.85, 727.74 and 991.62 per cent respectively. Statistically, iron content of all the incorporated formulations was significantly high when compared with each other as well as with control recipe.

Lowest calcium content of 21.59 g was present in control *namakpare* made from refined flour, *ajwain* and oil only. As the cress powder was added in the basic recipe in different proportions, the amount of calcium content increased significantly. *Namakpare* incorporated with highest level of cress powder i.e. 20 g had significant high calcium content of 91.79 affecting per cent increment of 325.15. Formulations incorporated at the level of 5,10,15 per cent of germinated garden cress powder had calcium content of 38.62, 56.19 and 75.53 mg having significant per cent rise of 78.87, 160.25 and 249.83. When compared statistically significant difference ($P \leq 0.05$) was observed in between the calcium content of all the formulations and also when compared with N_1 (control) *namakpare*.

Of all the formulations, N_5 i.e. 20 per cent incorporated *namakpare* contained the maximum amount of phosphorous content of 239.86 mg while the controlled *recipe* had minimum content of 119.25 mg. N_2, N_3, and N_4 treatments were analysed with phosphorus content of 149.43, 179.96 and 210.31 mg per 100g. When compared statistically, significant difference was calculated when phosphorus content of experimental formulations was compared with each other as well as with controlled *namakpare.*

As for the proximate parameters, 20 per cent cress incorporated formulation had highest amount of iron, calcium and phosphorus when compared with all other formulations. There was progressive increase in the mineral content as the amount of germinated garden cress seeds powder increased in the recipes. This effect was also observed by Agarwal and Sharma (2013) who did mineral analysis of *mathri* prepared by incorporating treated garden cress powder (roasted, microwave, whole) at three levels viz. 2.5%, 5% and 7.5 %. Mineral analysis of *chikki* by Laxmanrao and Rupnar (2015) revealed that controlled *chikki* had minimum amount of minerals as compared to the *chikki* incorporated with garden cress seeds. Control *chikki* had 3 mg and 100 mg of iron and calcium whereas acceptable version i.e. *chikki* with 10 per cent of incorporated garden cress powder had 12.37 and 233.75 mg of iron and calcium.

Conclusion

Garden cress seeds though are very small in size but they contain appreciable amounts of macro and micro nutrients and also possess health enhancing properties. They also hold galactagogue properties which promote lactation and prevent postnatal complications. Considering these properties, a savoury snack i.e *namakpare (matar)* was formulated for the lactating mothers. There was significant and proportionate increase in nutritive profile of *namakpare* with increase in levels of supplementation. So, highest nutritive value was assessed for treatment N_5 i.e. *namakpare* having 20 per cent addition of germinated cress powder as it contained highest amount of macronutrients as well as micronutrients analysed, when compared with all other formulations.

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Conflict of interest: The authors declare that there is no conflict of interest regarding the publication of this paper.

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