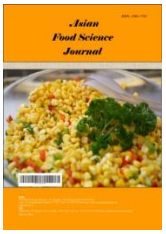

*Asian Food Science Journal*

***21(11): 64-70, 2022; Article no.AFSJ.93502***
***ISSN: 2581-7752***

# Development and Organoleptic Evaluation of *Chakli* Prepared from Green Gram Flour (*Vignaradiata L. Wildzek.)* and Moth Bean Flour *(Vignaacontifolia)*

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***Authors' contributions***

*This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.*

***Article Information***

DOI: 10.9734/AFSJ/2022/v21i11598

**Open Peer Review History:**
This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: https://www.sdiarticle5.com/review-history/93502

***Original Research Article***

***Received 03 September 2022***
***Accepted 08 November 2022***
***Published 12 November 2022***

## ABSTRACT

The present study was undertaken with the objectives of evolving *chakli* containing green gram flour and moth bean flour to find out their acceptability and nutritive value. *Chakli* were prepared by using refined flour, green gram flour, moth bean flour, salt, red chilli powder and refined oil by substituting refined flour with green gram flour and moth bean flour. The different samples prepared were Control , Sample 1, Sample 2 and Sample 3 in the ratios of (refinedflour:*green gram flour: moth bean flour*) 100, 50:25:25, 50:45:5, 50:5:45 respectively. The developed *chakli* were sensory evaluated using nine point hedonic scale. Results showed that overall acceptability for Sample 3 (7.85±0.81) *Chakli* were lying in between the category of 'like very much and like extremely whereas Control (7.6±1.53) were lying in the category of 'like moderately and like very much' by panelists.Highest energy, protein, carbohydrate and fat content were observed in Sample2 *Chakli* (520.8 kilocalories), (17.5 gram), (65.3 gram) and (22.2gram) respectively. Likewise fiber, calcium and iron content were observed in Sample 3 *Chakli* (2.4 gram) (108.6 milligram) and (5.84 milligram) respectively. *Chakli* (Sample 3) was most acceptable and analysed for proximate and mineral content along with control sample. Result shows that *chakli* prepared with green gram flour and moth bean flour (Sample 3) was found to be higher in protein (15.8 gram), fibre (1.9 gram), ash

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(2.5%), moisture (5.2%), calcium (19 milligram) and iron (1.1 milligram) than control *chakli*. Thus replacement of traditional food like refined flour with green gram flour and moth bean flour for preparing *chakli* is feasible and beneficial too and also were very accepted.

*Keywords: Green gram; moth bean; hedonic scale; nutritive value.*

## 1. INTRODUCTION

India is the largest producer and consumer of pulses in the whole world. Pulses play a very important role in Indian Agriculture. Pulses are the significant source of dietary protein in the vegetarian diet. Pulses maintain soil's fertility and these are good and rich source of protein as well. They maintain the fertility of soil through the biological nitrogen and fixation process, so it plays a very necessary role in developing and to promote the sustainable agriculture. Green gram or mung bean (*Vignaradiata [L.] Wilczek*) is well known leguminous crop that belongs to the subgenus Ceratotropis. The annual world production area of green gram is about 1510 thousand tonnes which shares 8.77% total production of pulses. India is the primary green gram producer and contributes about 75% of the world production [1].

Moth bean (*Vignaaconitifolia* L.) is a draught resistant legume, belonging to the family *Fabaceae,* commonly grown in arid and semiarid regions of India. It is exceptionally hardy legume and known by various other names including mat bean, matki, Turkish gram, or dew bean. India's driest state, Rajasthan is the major moth bean growing state [2]. During the period of five years (1990- 1994) *kharif* pulses in Rajasthan were grown in 37.23 lakh ha, with production of 8.45 1akh ton and productivity of 226 kg ha, the corresponding figures for moth bean were: 12.78, 2.70 and 211. It is however, significant to mention that moth bean alone shares almost 34.32% area and 32.00% production of total *kharif* pulses in this state. However, moth bean may not be rated as a national pulse; for instance, its national contribution to pulses is hardly 5.9 in area and 1.6% in production. On the contrary, it appears to be a major pulse, as far the hot and dry regions of India are concerned [3].

*Chakli* is a unique traditional food in a particular region where people mostly eat as a snack form. Due to globalization and modernization, people preference for fast food is increasing at a considerably greater amount. Due to heavy workloads in office works, they are preferring quick and light meal which can be eaten anywhere and anytime. But due to unbalanced diet causing due to frequent consumption of fast food, many are prone to various diseases resulting in an unhealthy lifestyle. Hence to overcome those problems, the demand for healthy and nutritious food is on rise [4-6]. Consumption of balanced diet having all the required constituents can help in preventing diseases and can result in initiation of a healthy lifestyle. Hence for maintaining a balanced diet, consumption of cereal and pulse based products is essential. Due to combination of different flour there is a considerable increase in nutritional profile of that product and thus ultimately benefitting the health and lifestyle after consumption [7]. The objective of this work were to prepare *chakli* with different proportions of refined flour, green gram flour and moth bean flour to characterize their nutritional value and to evaluate the *chakli* acceptance by panel member.

## 2. METHODOLOGY

### 2.1 Procurement of Green Gram Dhal *(Vignaradiata L. Wildzek)* and Moth Bean Dhal *(Vignaacontifolia)*

Green Gram *(Vigna Radiata L. Wildzek)* and Moth Bean *(Vigna Acontifolia)* were procured from Sector-46 market of Chandigarh.

### 2.2 Processing of green gram dhal *(Vignaradiata L. Wildzek)* and moth bean dhal *(Vignaacontifolia)*

The clean and healthy pulses of green gram and moth bean were used for preparation of flour. These were roasted in a pan and then cooled down for grinding. After that pulses were grinded with the help of electric grinder in order to make a powder and after that powder was sieved through a mesh siever to obtain a fine powder. The powdered samples were stored in an air tight container until further use for experiment.


**Fig. 1. Flow chart of processing of green gram flour *(Vignaradiata L. Wildzek)* and moth bean flour *(Vignaacontifolia)***

## 2.3 Standardization and Development of *Chakli*

Formulation was prepared by blending refined flour, green gram flour and moth bean flour in different proportions. Table 1 depicted different combinations of flour of refinedflour, green gram flour and moth bean flour.

## 2.4 Preparation of *Chakli*

Sieved the flour, salt and red chilli powder all together. Add oil, water and started to knead the dough. The dough should not be soft, but firm. Cover and let the dough rest for 30 minutes. Once the dough has rested, apply some water in the chakli maker. Place a ball in chakli maker and press the chakli maker to prepare the chakli. Place chakli on butter paper or parchment paper. Fry chakli till golden brown. Drain the chakli on paper napkins to removed excess oil.

## 2.5 Sensory Evaluation of *Chakli*

The developed value added *chakli* was selected using sensory evaluation technique with the help of 15 panel members using 9- point hedonic scale. Most acceptable level of green gram flour and moth bean flour in *chakli* was further analyzed for its nutrient content.

## 2.6 Nutritional Evaluation of *Chakli*

Nutritive values of all the *chaklis* were calculated using Nutritive value of Indian foods by [9].

## 2.7 Estimation of Proximate Composition and Mineral Content of Standard and Most Acceptable *chakli*

Moisture, crude protein, fat, ash, crude fiber, iron and calcium were determined by the method of [8] and carbohydrate (calculation).

**Moisture:** Moisture content was determined by employing the standard method of analysis [8].

**Procedure:** Ten gram of the sample was weighed in a petri dish and dried in an oven at 105$^{o}$C for six hours or till a constant weight was obtained. The sample was weighed after cooling it in desiccators.

$$\text{MOISTURE}(\%) = \frac{\text{Loss in weight(gram)}}{\text{Weight of the sample(gram)}} \text{x}100$$

**Crude protein:** The total nitrogen was estimated by a standard method of [8]. The crude protein was calculated by using the conversion factor of 6.25.

**Reagents:** 1. Hydrochloric acid (N/100) 2. Boric acid (4%) 3. Sodium hydroxide (40%) 4. Digestion mixture: 10 gram K2SO4, 0.5 gram CuSO4.6H20 and 2 gram FeSO4. 5. Mixed indicator solution: Dissolved 0.1 gram methyl red and 0.5 gram bromocresol green in 100 ml of 95% ethanol and the solution was adjusted with drops of dilute NaOH to bluish purple colour.

**Procedure:** Two hundred milligrams sample was taken and digested with 20 ml concentrated H2SO4 and a pinch of digestion mixture. The nitrogen, as ammonical salt, was diluted with 40 per cent NaOH in a Microkjeldahl apparatus. The ammonia thus liberated was absorbed in 10 ml boric acid solution containing a few drops of mixed indicator and was titrated against standard HC1 (N/100). The end point was indicated by the change of color from bluish-green to pink.

$$\text{Crude protein}(\%) = \frac{0.00014\text{x}V\text{x}(S - B)\text{x}100}{V_1\text{x}W} \text{xF}$$

Where, W = weight (g) of sample taken V = volume (m1) made V1 = volume (ml) of aliquot taken for distillation S = volume (m1) of HCI

(N/100) used in titration for blank B = volume (ml) of HC1 (N/100) used in titration for blank 0.00014 = 10 ml of 0.1 N HCI neutralize 0.00014 gram of nitrogen F = factor for converting N to protein (6.25).

**Crude fat:** Crude fat was estimated by a standard method of [8] using the soxhlet extraction apparatus. Procedure: Five gram of moisture free sample was taken and transferred to an extraction thimble and then weighed. The thimble was placed in a soxhlet extractor fitted with a condenser and flask containing sufficient petroleum ether. The extraction was carried out for six hours. After the extraction thimble was removed with the sample from the desiccator and weighed. The loss in weight of the thimble was the estimate of the ether extract in the sample.

$$\text{Crude fat}(\%) = \frac{\text{Loss of weight(gram)}}{\text{Sample weight(gram)}} \text{x100}$$

**Crude fiaber:** Crude fiber in the sample was determined by standard method of analysis [8]

**Reagents:** 1. Hydrochloric acid (%) v/v 2. Sulphuric acid stock solution (10%) v/v: Diluted 55 ml concentrated sulphuric acid to 1 L. 3. Sulphuric acid working solution (1.25%): Diluted 125 ml of stock solution to 1L. 4. Sodium hydroxide stock solution (10%) w/v: Dissolved 100 gram of NaOH in distilled water and diluted to 1 L. 5. Sodium hydroxide workine solution (1.25%): Diluted 125 ml stock solution to 1 L with distilled water. 6. Antifoam (2%): Silicon in CCI4.

**Procedure:** Two gram fat free dried sample was put in 1L tall beaker and 200 ml 1.25 per cent H2SO4 and a few drops of antifoam were added. The solution was kept for boiling for 30 minutes under bulb condenser. Beaker was rotated occasionally to mix the contents and remove the particles from sides. The contents were filtered into the beaker through Buchner funnel. The sample was washed back into the beaker with 200 ml 1.25 per cent NaOH and again boiled for exactly 30 minutes. All the insoluble mass was transferred to the crucible (G-1) by means of boiling distilled water till acid free. Washed twice with alcohol and thrice with acetone, and then dried at 100 ♌C to constant weight. The dried material was ashed in a muffle furnace at 550 ♌C for one hour. The crucible was cooled in a desiccator and weighed.

$$\text{Crude fiber}\ (\%) = \frac{W_2 - W_3}{W_1} \text{x100}$$

Where, W1= weight (g) of sample W2 =weight (g) of insoluble matter (wt. of crucible-insoluble matter- wt. of crucible) W3 = weight (g) of ash (crucible + ash - wt. of crucible).

**Carbohydrate:** Add up to the values of moisture, crude protein, crude fat, crude fiber and ash and subtract from 100. The difference will give value of available carbohydrates.

**Iron:** Iron in the sample was determined by standard method of analysis Titrimetric method [8].

**Reagents:** Concentrated HCl. 2. Ortho-phenanthroline solution: Dissolve 0.1 gram of o-phenanthroline in 80 nil glass distilled water at 80 ♌C, cool and make the volume to 100 ml. 3. Hydroxylamine hydrochloride (10%). 4. Acetate buffer solution: Dissolve 8.3 gram anhydrous sodium acetate in glass distilled water. Add 12 ml acetic acid and dilute to 100 ml. 5. Standard iron solution: Dissolve 3.5 gram of ferrous ammonium sulphate in water. Add 2 drops of HC1 and dilute to 500 ml. Dilute 10 ml of this solution to 1 L.

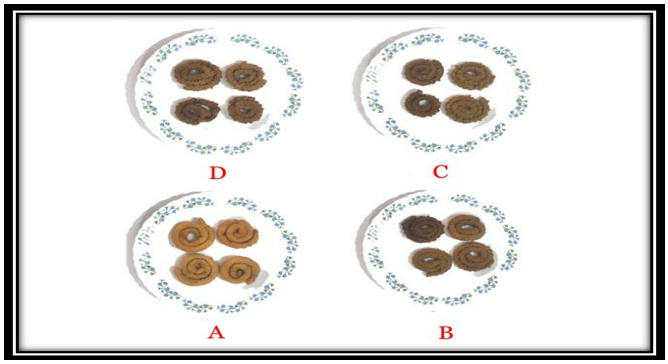


**Fig. 2. Different morphological characteristics of *Chakli***

**Procedure:** The extract prepared after ashing the food sample is used for estimation of iron. 10 ml of aliquot are pipette in the 25 ml volumetric flask and add 1 ml of hydroxylamine hydrochloric solution. In a few minutes, add 5 ml of buffer solution and 1 ml of the ortho-phenanthroline solution. The contents are mixed and volume is made up to the mark. The intensity of color developed is measured at 540 nm in a spectrophotometer. Blank: 2 ml of conc. HCl is diluted to 100 ml and 10 ml of this solution is treated as per sample. Standard: 5, 10, 20, 30, 40, 50 ml of standard iron solution are transferred to 100 ml volumetric flask. Add 2 ml of conc. HCl to each flask and volume is made to 100 ml. Aliquot of 10 ml of each flask are heated as in the case of sample. A calibration curve is drawn with reading of standard solution. The concentration of iron in the unknown sample is calculated from the standard curve and multiplying with dilution factor.

**Calcium:** Calcium in the sample was determined by standard method of analysis Titrimetric method [8].

**Reagents:** 1. Saturated ammonium oxalate solution. 2. Dilute hydrochloric acid (1 part HCl + 4 part water). 3. Methyl red indicator (0.5% in absolute alcohol). 4. Potassium permanganate solution 0.1 N. Dilute ammonium hydroxide (1 part NH4OH + 1 part water). 6. Dilute sulphuric acid (10%). 7. Oxalic acid solution 0.1N: Sodium oxalate is dried in an oven at 100 degree Celsius for 12 hours. Exactly 6.7 gram is dissolved in distilled water, 5 ml of conc. H2SO4 is added and solution made up to 1L, after it has cooled down.

Standardization of potassium permanganate solution: 10 ml of 0.1 N oxalic acid solutions is transferred to a conical flask. One ml conc. H2SO4 is added , warmed to about 70 degree Celsius titrated against KMnO4 solution, till the faint pink color remains.

**Procedure:** Take 50 ml of clear sample filtrate prepared from ash into a beaker. Add 10 ml of saturated ammonium oxalate solution. Boil and add two drops of methyl red indicator. The contents are neutralized with dilute ammonium hydroxide and boil the contents again to have coarse crystalline precipitate. Add a few drops of dilute hydrochloric acid until the color is adjusted to faint pink. The solution is allowed to stay overnight. The precipitates are filtered through Whatman filter paper and washed thoroughly with hot distilled water till the precipitates are free of oxalates. The precipitates along the filter paper are added in the original beaker and dissolved in 20 ml of 10 % sulphuric acid. The contents are heated to about 70$^{o}$C and titrated against 0.1 N potassium permanganate solutions to a faint pink color. A blank is also run using similar procedure. Calculations: I ml of 0.1 N KMnO4 used = 0.002 gram Calcium.

$$Calcium(\%) = ml\ of\ 0.1N\ KMnO\_(4\ )\ used x\ 0.002x\ A/B\ x\ 100\ /(weight\ of\ sample\ (gram)\ )$$

## 2.8 Statistical Analysis

All the obtained data of chemical analysis and sensory evaluation were statistically analyzed using Mean and Standard deviation according to the standard method.

## 3. RESULTS AND DISCUSSION

### 3.1 Sensory Evaluation of C*hakII*

Results of sensory evaluation of *chakli* prepared with green gram flour and moth bean flour presented in (Table 2) revealed that the overall acceptability of *chakli* ranged from 7.6-7.85. This indicated that the recipes were found under the category of “liked moderately and like very much”. Sample 3 *chakli* exhibit highest scores for all sensory attributes i.e.7.5±0.83(appearance), 7.9±0.91 (color), 7.7± 1.08 ( texture), 7.8± 0.89 ( flavor), 8±1.08 (taste), 7.85±0.81 ( overall acceptability) as compared to control sample which was prepared with only refined flour. So the incorporation of refined flour, green gram flour and moth bean flour with ratio 50:5:45 maintain liked very much on the basis of 9 point hedonic scale and this is an option to improve nutritional value of traditional *chakli.* Rana and Kaur (2015) carried out the sensory evaluation of products that were prepared by incorporating germinated moth bean flour. The *chakli* was prepared at 5%, 10% and 15% variations of moth bean flour. The control sample had the maximum overall acceptability (8.16±0.25) followed by 15% variation sample (8.14±0.13).

It was observed that *chakli*, Control contains 528 kilocalories energy, 11 gram protein, 73.9 gram carbohydrate, 20.9 gram fat, 0.3 gram crude fiber, 23 milligram calcium and 2.7 milligram iron. Sample 1 contains 520 kilocalories energy, 17.4 gram protein, 65.2 gram carbohydrate, 21.05 gram fat, 2.3 gram crude fiber, 93 milligram calcium and 4.82 milligram iron. Sample

**Table 1. Proportion of *Chakli***

| Sr.No. | Ingredients | Control | Sample 1 | Sample 2 | Sample 3 |
|---|---|---|---|---|---|
| 1 | Refined Flour | 100% | 50% | 50% | 50% |
| 2 | Green Gram Flour | - | 25% | 45% | 5% |
| 3 | Moth Bean Flour | - | 25% | 5% | 45% |

**Table 2. Mean scores of sensory evaluation of *Chakli***

| Samples | Appearance | Color | Texture | Flavor | Taste | Overall acceptability |
|---|---|---|---|---|---|---|
| Control (Rf::100) | 7.25±1.21 | 7.4±1.31 | 7.15±1.56 | 7.35±1.39 | 7.35±1.42 | 7.6±1.53 |
| Sample 1(Rf:Gg:Mb::50:25:25) | 7.15±1.27 | 7.55±0.89 | 7.6±0.93 | 7.7±0.73 | 7.9±0.82 | 7.8±0.77 |
| Sample 2 (Rf:Gg:Mb::50:45:5) | 7.4±1.14 | 7.75±0.91 | 7.65±1.09 | 7.7±0.98 | 7.75±0.96 | 7.7±1.03 |
| Sample 3 (Rf:Gg:Mb::50:5:45) | 7.5±0.83 | 7.9±0.91 | 7.7±1.08 | 7.8±0.89 | 8±1.08 | 7.85±0.81 |

*Rf: Refined flour Gg: Green gram dhal Mb: Moth bean dhal*

**Table 3. Nutritive value of *Chakli***

| Samples | Energy (kcal) # | Protein (g) # | Carbohydrate (g) # | Fat (g) # | Crude fiber (g) # | Calcium (mg) # | Iron (mg) # |
|---|---|---|---|---|---|---|---|
| Control(Ww::100) | 525 | 6.8 | 78.2 | 20.5 | 0.3 | 23 | 2.7 |
| Sample 1(Rf:Gg:Mb::50:25:25) | 518.5 | 15.3 | 67.4 | 20.8 | 2.3 | 93 | 4.82 |
| Sample 2 (Rf:Gg:Mb::50:45:5) | 519.3 | 15.3 | 67.4 | 20.9 | 2.21 | 77.4 | 3.8 |
| Sample 3 (Rf:Gg:Mb::50:5:45) | 517.7 | 15.2 | 67.3 | 20.8 | 2.37 | 108.6 | 5.8 |

*Rf: Refined flour Kcal: Kilocalorie Gg: Greengram dhal g: Gram Mb: Mothbean dhal mg: Milligram # Gopalan et al. [5]*

**Table 4. Proximate composition and mineral content of C*hakli***

| Proximate composition | Control | Sample 3 |
|---|---|---|
| Moisture (%) | 4.92 | 5.2 |
| Protein(g) | 11.4 | 15.8 |
| Fat(g) | 25.8 | 25 |
| Fibre(g) | 1.5 | 1.9 |
| Ash (%) | 2.1 | 2.5 |
| Carbohydrate(g) | 55 | 51.5 |
| **Mineral content** | | |
| Calcium(mg) | 15 | 19 |
| Iron(mg) | 0.5 | 1.1 |

2 contains 520.8 kilocalories energy, 17.4 gram protein, 65.2 gram carbohydrate, 22.18 gram fat, 2.21 gram crude fiber, 77.4 milligram calcium and 3.77 milligram iron. Sample 3 contains 519.2 kilocalories energy, 17.32 gram protein, 65.2 gram carbohydrate, 21.01 gram fat, 2.37 gram crude fiber, 108.6 milligram calcium and 5.84 milligram iron.

The data in respect to proximate composition and mineral content of standard (Control) and most acceptable green gram flour and moth bean flour Chakli (Sample 3) and pictorial representation was depicted in Table 3. It was observed that Sample 3 has more calcium (19 mg), iron (1.1 mg), ash (2.5%), moisture (5.2%) , protein(15.8g) and fiber(1.9g) than Control (15mg), (0.5mg), (2.1%), ( 4.92%),(11.4g) and (1.5 g) respectively. However control has more fat (25.8g) and carbohydrate (55g) than Sample 1 (25g), (51.5g) respectively.

## 4. CONCLUSION

It was found that green gram and moth bean flour can successfully be incorporated for the development of food products to provide benefit to the ones who eat. Findings revealed that overall acceptability of *chakli* ranged from 7.6-7.85(liked moderately to liked very much). Adding green gram flour and moth bean flour with refined flour in traditional foods is a useful strategy to increase the consumption of protein, calcium and iron in the human diet. Green gram and Moth bean Flour can be used as a healthy alternative to other grains in our diet and can be included in commonly consumed recipes to make our diet more wholesome and nutritious.

## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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