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Research Journal of Agricultural Sciences
Volume 14; Issue 05 (Sep-Oct 2023); pp 1401–1405

ISSN: 0976-1675 (P)
ISSN: 2249-4538 (E)

Full Length Research Article

# Development of Value-added Products from Ivy Gourd (*Coccinia grandis*) Fruit Powder Having Good Shelf Life

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## Abstract

Ivy gourd is a perennial underutilized fruit grown in India. It is an indigenous herb plant of Central Asia and Africa, and is a medicinal plant that is widely produced in India. The study was carried out with an objective to determine shelf life of Ivy gourd fruit powder and, later, develop value-added products using it. Shelf life of fruit powder was carried out using sensory, microbial, and biochemical evaluation over a period of 3 months. The results showed decrease in its sensory scores with increase in storage period. Biochemical evaluation revealed no major changes, except for moisture content that increased with increase in storage period. Microbial population too, increased with time, however, it was found to be within permissible limit. Four food products were developed by incorporating fruit powder, namely, *ragi* vegetable *chilla,* garlic yogurt dip, *methi raita* and *missi chapatti,* by adding fruit powder in three proportions (4g, 8g and 12g) and their sensory evaluation was conducted to determine the most acceptable from each category. Three of the four products showed best acceptability at 4g incorporation of fruit powder, i.e., garlic yogurt dip, *missi chapatti, methi raita,* while *ragi* vegetable *chilla,* was best accepted at 8g level.

***Key words*:** *Coccinia grandis,* Fruit powder, Product development, Shelf-life, Microbial growth, Value added product

India is the habitat to about 7000 different plant species. Even though most of them have a long and rich history in folk medicine, there is a dearth of written information about their effectiveness, formulation, and therapeutic characteristics, particularly amongst human. Many of these plants are however, used to treat diseases, like diabetes mellitus, heart diseases and some forms of cancer [1]. Over 6000 plants are reported to be used in traditional, folk, and herbal medicine in India. Their production has been exponentially high in recent years, and their use for treatments are gaining prominence in both developed and developing countries due to their natural origin and fewer negative impacts [2]. Ivy gourd (*Coccinia grandis*), an indigenous herbal plant of Central Asia and Africa, is one such medicinal plant. It is widely produced in India, and its natural variant may also be found in many regions of the country. This plant has long been utilized in the traditional Indian medical systems of Ayurveda, Unani, and Siddha [3].

Ivy gourd, often known as baby watermelon, is another tropical perennial creeper cultivated in India. It is a member of the Cucurbitaceae family, and its scientific name is *Coccinia cordifolia* and its binomial name is *Coccinis grandis* (L.) Voigt. The morphological characteristics of plant exhibits leaves to be placed alternately all along the stems and their forms range from heart to hexagon, which can be up to 80 mm wide and long. The fruit is green in colour, ovoid to elliptical in shape, 45–70 mm long, 15–35 mm wide, and glabrous. The stem is an herbaceous climber and has a bushy, wavy appearance. The juvenile stem is soft and roots are succulent allowing the plant to withstand prolonged drought [4].

Fig 1 Ivy gourd herb

Fig 2 Ivy gourd fruit

Diabetes is mostly treated using medications such as sulfonylures, D-phenlaline, biguanides, and alpha-glucosidase inhibitors in conjunction with insulin dosages. Because these medications and insulin having significant side effects and are expensive, there is an urgent need to switch to herbal treatment for diabetes that has fewer or no negative effects. The secondary data also supports that the fruit, leaves, stems and root of Ivy gourd herb has anti-diabetic properties and can be used in treatment of the disease. The reasons reported are that this herb contains good amount of triterpenoids and pectin, which help in

Received: 18 Jun 2023; Revised accepted: 24 Sep 2023; Published online: 29 Sep 2023

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**Citation:** Singh A, Joshi I. 2023. Development of value-added products from Ivy gourd (*Coccinia grandis*) fruit powder having good shelf life. *Res. Jr. Agril. Sci.* 14(5): 1401-1405.

lowering blood sugar level. Triterpenoids can inhibit enzymes involved in glucose metabolism, prevent development of insulin resistance and normalize plasma glucose and insulin levels [5]. Pectin has the ability to increase viscosity which leads to lesser intestinal absorption of glucose [6]. Keeping this in mind, the present study was designed with an objective to study shelf life of Ivy gourd fruit powder and development of value-added products by incorporating the same.

## MATERIALS AND METHODS

The fruit of ivy gourd herb was selected as it contains good amount of triterpenoids and pectin that have anti-diabetic properties.

*Procurement and processing of ivy gourd fruit*

The stems of ivy gourd (*Coccinia grandis*) were procured from Rajasthan Agricultural Research Institute (RARI), Durgapur, Jaipur (Rajasthan), which were then planted in the kitchen garden under proper supervision. The fruits on ripening were plucked, washed, cut into slices and shade dried. Thereafter, these were put in hot air oven for removal of moisture, followed by grinding into fine powder and storage in air tight containers for further use.

*Shelf-life analysis of fruit powder*

Shelf-life analysis was carried out using the following methods:

*Sensory evaluation*: Powder was assessed organoleptically for colour, appearance, odour, taste, and texture, by a panel of 10 semi trained judges to determine its overall acceptability.

*Microbial evaluation*: For this, standard plate count method was used.

*Biochemical estimation*: Powder was estimated for its peroxide value, moisture content, nutrient content, (protein, fat, pectin) and triterpenoid content, using standard methods and chemicals of analytical grade.

*Product development by incorporating fruit powder*

Four value added products viz. *ragi* vegetable *chilla*, garlic yogurt dip, *missi chapati* and *methi raita* were developed by incorporating Ivy gourd fruit powder.

*Selection and standardization of the recipe*

Keeping in mind the objectives of the study, i.e., to develop food products by adding Ivy gourd powder in different proportions, products were formulated and assessed for their sensory attributes viz. portion size, shape, colour, taste, etc.

*Coding of standardized recipes and developed products*

The development of products was carried out in the Foods and Nutrition laboratory of the university. For coding, both, alphabet and numbers were used. The numeric codes were assigned to different proportions in which fruit powder was added to the products *i.e.*, 001 for 4g, 002 for 8g, and 003 for 12g. Alphabetical codes were based on the name of the products, viz. RC for *ragi* vegetable *chilla*, GD for garlic yogurt dip, MC for *missi chapati* and MR for *methi raita*. The basic recipe of each product was treated as control and were assigned a code, viz. RCC001 for control of *ragi* vegetable *chilla*, GDC001 for control of garlic yogurt dip, MCC001for control of *missi chapati* and MRC001 for control of *methi raita*.

*Sensory evaluation of developed product*

The developed products were assessed by a panel of 10 members, using nine-point hedonic scale.

*Statistical analysis*

Mean and standard deviation of the data were calculated and the variation between the results of shelf-life study and developed products were determined by one-way ANOVA and significant differences were evaluated at $p < 0.05$.

## RESULTS AND DISCUSSION

The results of shelf life of Ivy gourd fruit powder and value-added products for diabetics are presented in the sections below:

*Shelf-life analysis of ivy gourd fruit powder*

Shelf-life study of the fruit powder was analyzed over a period of 3 month, at an interval of 15 days, using standard methods.

*Analysis of microbial quality*

The Ivy gourd fruit powder was analyzed for microbial quality during storage period of 3 months, using standard plate count. The results revealed total viable bacterial count of fruit powder to range from $13.33x10^2 \pm 1.52$ to $311x10^2 \pm 10.01$ CFU/g from day 1 to day 90, respectively (Table 1). Significant difference in bacterial count could be seen only after 45 days of storage period, when compared with that of day 1 (Table 1, Fig 3).

Table 1 Mean bacterial count of ivy gourd fruit powder during storage

| Days | Fruit sample ($\times 10^2$ CFU/100g) |
|---|---|
| Day 1 | $13.33 \pm 1.52^a$ |
| Day 15 | $25.33 \pm 5.85^a$ |
| Day 30 | $81.00 \pm 12.76^a$ |
| Day 45 | $106.33 \pm 2.08^a$ |
| Day 60 | $157.66 \pm 3.21^b$ |
| Day 75 | $223.66 \pm 3.05^b$ |
| Day 90 | $311 \pm 10.01^b$ |

Mean ± Standard Deviation; Means with different superscripts in column denote significant difference (p≤0.05)

*Analysis of moisture content and peroxide value*

Analysis of nutritional quality of fruit powder showed mean moisture content to range from 18.02±0.07 per cent on the day 1 to 34.05±0.57% on the 90$^{th}$ day of storage period (Table 2, Fig 4). Significant difference could be seen from 75$^{th}$ day onwards. However, peroxide value was not detected in the sample during the complete storage period of 90 days.

Table 2 Mean moisture content and peroxide value of fruit powder during storage

| Days | Moisture (%) | Peroxide value (mEqO2/1000g) |
|---|---|---|
| Day 1 | $18.02 \pm 0.07^a$ | ND |
| Day 15 | $24.00 \pm 00.0^a$ | ND |
| Day 30 | $26.78 \pm 0.00^a$ | ND |
| Day 45 | $27.80 \pm 0.00^a$ | ND |
| Day 60 | $28.03 \pm 0.17^a$ | ND |
| Day 75 | $32.00 \pm 0.00^b$ | ND |
| Day 90 | $34.05 \pm 0.57^b$ | ND |

Mean ± Standard Deviation, ND- Not Detectable
Means with different superscripts in column denote significant difference (p≤0.05)

*Analysis of nutrient content*

Non-significant change (p≤0.05) in mean protein content was observed during the storage period (Table3, Fig 5). Its content decreased marginally from 16.76±0.76 g/100g on day 1 to 16.01±0.23g/100g on day 90. Similarly, pectin and triterpenoid content showed non-significant decrease (p≤0.05) during the storage period, the same being 3.48±0.35g/100g on day 1, and 3.37± 0.00g/100g on day 90 for pectin, and 0.97±0.01mg/100g on day 1 and 0.94±0.00mg/100g on day 90 for triterpenoid content (Table 3, Fig 6). Estimation of fat content showed non-detectable amount.

*Sensory evaluation of ivy gourd fruit powder*

The results of sensory evaluation of Ivy gourd fruit powder for its various attributes during storage period of 90 days are presented in (Table 4). The mean sensory scores showed declining trend, the same reduced from 7.9±0.57 to 4.3±0.49 for appearance, 8.0±0.47 to 4.7±0.49 for colour, 8.1±0.57 to 4.4±0.53 for taste, 7.6±0.70 to 4.4±0.53 for texture, 8.0±0.47 to 4.1±0.38 for after taste and 8.2±0.42 to 4.1±0.38 for overall acceptability (Table 4, Fig 7). The mean sensory scores for various sensory attributes were acceptable till 30 days, thereafter, significant difference was observed (p≤0.05).

Table 3 Mean nutrient content of Ivy gourd fruit powder during storage

| Days | Protein (g/100g) | Pectin (g/100g) | Triterpenoid (mg/100g) |
|---|---|---|---|
| Day 1 | 16.76±0.76$^{a}$ | 3.48±0.35$^{a}$ | 0.97±0.01$^{a}$ |
| Day 15 | 16.44±1.61$^{a}$ | 3.49±0.00$^{a}$ | 0.95±0.00$^{a}$ |
| Day 30 | 16.26±0.57$^{a}$ | 3.49±0.00$^{a}$ | 0.95±0.00$^{a}$ |
| Day 45 | 16.06±0.54$^{a}$ | 3.42±0.00$^{a}$ | 0.95±0.00$^{a}$ |
| Day 60 | 16.06±0.80$^{a}$ | 3.42±0.15$^{a}$ | 0.94±0.00$^{a}$ |
| Day 75 | 16.01±0.18$^{a}$ | 3.40±0.05$^{a}$ | 0.94±0.02$^{a}$ |
| Day 90 | 16.01±0.23$^{a}$ | 3.37± 0.00$^{a}$ | 0.94±0.00$^{a}$ |

Mean ± Standard Deviation

Means with different superscripts in column denote significant difference (p≤0.05)

Table 4 Mean sensory scores of ivy gourd fruit powder during storage period

| Days | Appearance | Colour | Taste | Texture | After taste | Overall acceptability |
|---|---|---|---|---|---|---|
| Day 1 | 7.9±0.57$^{a}$ | 8.0±0.47$^{a}$ | 8.1±0.57$^{a}$ | 7.6±0.70$^{a}$ | 8.0±0.47$^{a}$ | 8.2±0.42$^{a}$ |
| Day 15 | 7.6±0.70$^{a}$ | 7.7±0.67$^{a}$ | 7.9±0.57$^{a}$ | 7.2±0.63$^{a}$ | 7.1±0.74$^{a}$ | 7.6±0.52$^{a}$ |
| Day 30 | 6.7±0.52$^{b}$ | 6.5±0.55$^{b}$ | 6.0±0.89$^{b}$ | 6.0±0.63$^{b}$ | 5.8±0.75$^{b}$ | 6.5±0.55$^{b}$ |
| Day 45 | 5.3±0.76$^{b,c}$ | 5.4±0.53$^{b,c}$ | 5.4±0.53$^{b,c}$ | 5.6±0.53$^{b,c}$ | 5.4±0.53$^{b,c}$ | 4.3±0.49$^{b,c,e}$ |
| Day 60 | 6.3±0.76$^{b}$ | 6.3±0.49$^{b}$ | 5.7±0.95$^{b}$ | 5.9±0.69$^{b}$ | 5.6±0.98$^{b}$ | 5.6±0.98$^{b}$ |
| Day 75 | 5.3±0.49$^{b,c}$ | 5.3±0.$^{95b,c}$ | 5.0±1.00$^{b}$ | 4.9±0.69$^{b,c}$ | 4.7±0.76$^{b,c,d}$ | 4.9±0.69$^{b}$ |
| Day 90 | 4.3±0.49$^{b,c}$ | 4.7±0.$^{49b,c}$ | 4.4±0.53$^{b,c}$ | 4.4±0.53$^{b,c}$ | 4.1±0.38$^{b,c}$ | 4.1±0.38$^{b,c}$ |

Mean ± Standard Deviation

Means with different superscripts in column denote significant difference (p≤0.05)

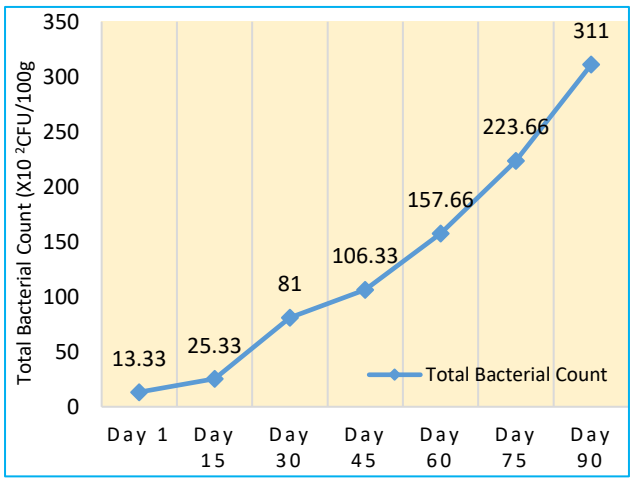


Fig 3 Mean total bacterial count of fruit powder (×10² CFU/100g) during storage period

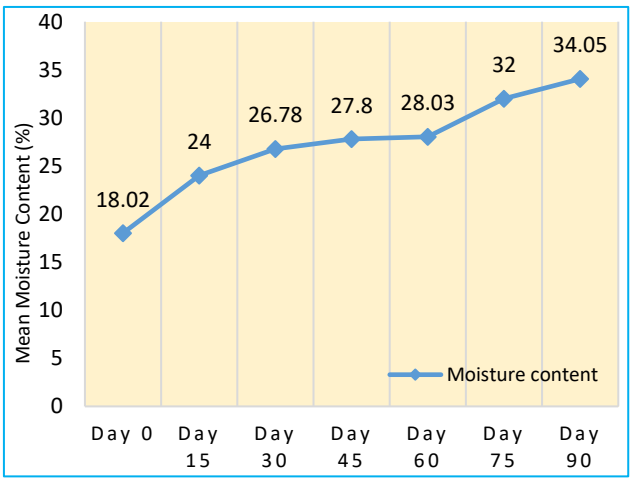


Fig 4 Mean moisture content (%) of fruit powder during storage period

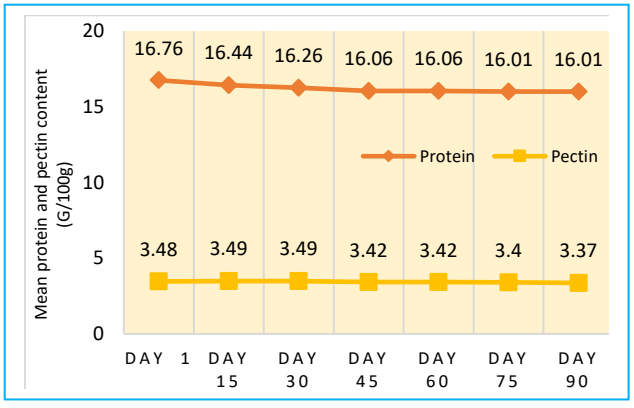


Fig 5 Mean protein and pectin content (g/100g) of fruit powder during storage period

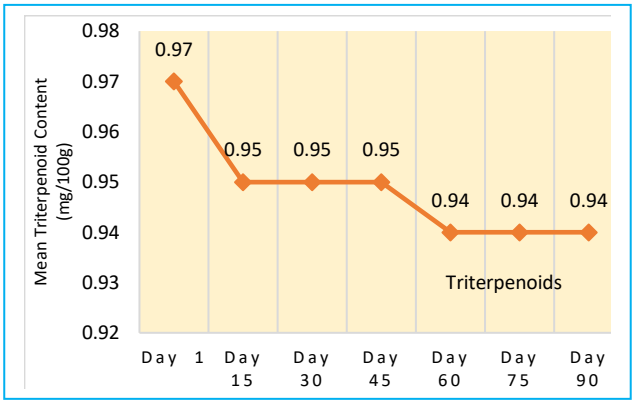


Fig 6 Mean triterpenoid content (mg/100g) of fruit powder during storage period

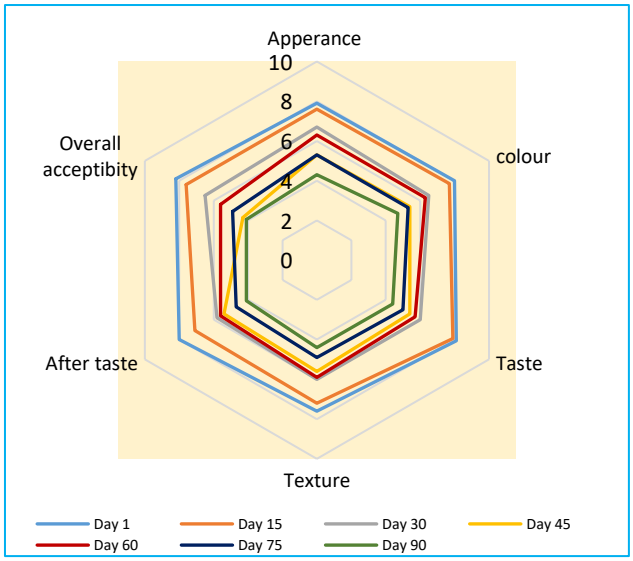


Fig 7 Mean sensory scores of fruit powder during storage period

*Product development*

The organoleptic evaluation of the developed food products viz., *ragi* vegetable *chilla*, garlic yogurt dip, *missi chapatti and methi raita* has been presented in (Table 5).

*Ragi* vegetable *chilla*

Sensory evaluation results of all the four variations of *ragi* vegetable *chilla* revealed addition of fruit powder to be most acceptable at 8g (RC002). In fact, its score for overall acceptability was even more than the control *chilla* (RCC001). It obtained highest mean scores for other attributes like, appearance (8.5±0.53), colour (7.9±0.32), taste (8.2±0.63), texture (7.9±0.57) after taste (7.6±0.52) and overall acceptability (7.9±0.57) (Table 5, Fig 7). It was liked very much by the panelist. Addition of fruit powder improved the appearance, colour, taste, and texture of *ragi chilla*, which could be due to the mild salty taste, light brown colour, and granular texture of fruit powder. A significant difference in sensory scores for various attributes was observed beyond 8g incorporation of fruit powder.

Table 5 Mean sensory scores of *ragi* vegetable *chilla* developed by incorporating Ivy gourd powder

| Sample code | Appearance | Colour | Taste | Texture | After taste | Overall acceptability |
|---|---|---|---|---|---|---|
| RCC001 (Control) | 7.8 ±0.63$^{a}$ | 7.6 ±0.52$^{a}$ | 7.8 ±0.92$^{a}$ | 7.7 ±0.67$^{a}$ | 7.7 ±0.67$^{a}$ | 7.7 ± 0.82$^{a}$ |
| RC001 (4g) | 7.8 ±0.79$^{a}$ | 7.4 ±0.97$^{a}$ | 7.6 ±0.70$^{a}$ | 7.6 ±0.70$^{a}$ | 7.9 ±0.57$^{a}$ | 7.6 ± 0.84$^{a}$ |
| RC002 (8g) | 8.5 ±0.53$^{a}$ | 7.9 ±0.32$^{a}$ | 8.2 ±0.63$^{a}$ | 7.9 ±0.57$^{a}$ | 7.6 ±0.52$^{a}$ | 7.9 ± 0.57$^{a}$ |
| RC003 (12g) | 7.3 ±1.42$^{b}$ | 7.1 ±0.99$^{b}$ | 6.8 ±0.63$^{b}$ | 7.0 ±0.82$^{b}$ | 7.1 ±0.99$^{b}$ | 7.2 ± 0.92$^{b}$ |

Mean ± Standard Deviation

Means with different superscripts in column denote significant difference (p≤0.05)

*Garlic yogurt dip*

Different variants of garlic yogurt dip were developed by incorporating ivy gourd fruit powder at 4g, 8g and 12g levels. The mean overall acceptability scores showed GD001 to be the most acceptable (7.8±1.58), having mean score almost similar to that of control GDC001 (7.9±1.46), followed by GD002 (6.6±1.30) and GD003 (6.4±1.30) (Table 6, Fig 8). The mean sensory scores for appearance, colour, taste, texture and after taste of GD001 were 7.9±1.25, 7.8±1.28, 7.9±1.64 7.8±1.28 and 7.9±1.73, respectively. It was observed that increase in proportion of ivy gourd fruit powder reduced the acceptability of the product, which is also apparent from the scores obtained. However, significant difference (p≤0.05) was observed at 8 and 12g of incorporation when compared with control and GD001.

Table 6 Mean sensory scores of garlic yogurt dip developed by incorporating ivy gourd powder

| Sample code | Appearance | Colour | Taste | Texture | After taste | Overall acceptability |
|---|---|---|---|---|---|---|
| RCC001 (Control) | 7.9 ±1.36$^{a}$ | 7.8 ±1.28$^{a}$ | 7.5±1.31$^{a}$ | 7.8±1.58$^{a}$ | 7.9±1.46$^{a}$ | 7.9 ±1.46$^{a}$ |
| RC001 (4g) | 7.9±1.25$^{a}$ | 7.8±1.28$^{a}$ | 7.9±1.64$^{a}$ | 7.8±1.28$^{a}$ | 7.9±1.73$^{a}$ | 7.8 ±1.58$^{a}$ |
| RC002 (8g) | 7.4±1.30$^{b}$ | 7.5±1.31$^{a}$ | 7.3±1.58$^{b}$ | 7.1±0.99$^{b}$ | 6.9±1.36$^{b}$ | 6.6 ±1.30$^{b}$ |
| RC003 (12g) | 7.0±1.31$^{b}$ | 7.1±1.25$^{b}$ | 6.9±1.25$^{b}$ | 6.5±0.93$^{b}$ | 6.8±1.28$^{b}$ | 6.4 ±1.30$^{b}$ |

Mean ± Standard Deviation

Means with different superscripts in column denote significant difference (p≤0.05)

Table 7 Mean sensory scores of *Missi chapati* developed by incorporating ivy gourd powder

| Sample code | Appearance | Colour | Taste | Texture | After taste | Overall acceptability |
|---|---|---|---|---|---|---|
| RCC001 (Control) | 8.4±0.84$^{a}$ | 8.3±0.82$^{a}$ | 8.4±0.97$^{a}$ | 7.9±0.74$^{a}$ | 8.2±0.79$^{a}$ | 8.4±0.52$^{a}$ |
| RC001 (4g) | 8.3±0.67$^{a}$ | 8.1±0.74$^{a}$ | 7.9±0.57$^{a}$ | 7.6±0.70$^{a}$ | 8.0±0.47$^{a}$ | 8.2±0.42$^{a}$ |
| RC002 (8g) | 7.6±0.97$^{b}$ | 7.6±0.97$^{b}$ | 7.4±0.84$^{b}$ | 7.2±1.03$^{b}$ | 7.2±0.63$^{a}$ | 6.9±0.57$^{a}$ |
| RC003 (12g) | 7.3±1.06$^{b}$ | 6.9±1.37$^{b}$ | 6.7±0.82$^{b}$ | 6.7±0.82$^{b}$ | 6.2±0.92$^{b}$ | 6.0±0.67$^{b}$ |

Mean ± Standard Deviation

Means with different superscripts in column denote significant difference (p≤0.05)

*Missi chapatti*

The other product developed was *missi chapatti* and its mean sensory scores are presented in (Table 7, Fig 9). Out of the three variants that were developed by incorporating ivy gourd fruit powder, the one at 4g level of incorporation i.e., MC001 showed highest acceptability (8.2±0.42), followed by MC002 (6.9±0.57) and MC003 (6.0±0.67). The mean sensory scores for various attributes of the best accepted variation (MC001) were 8.3±0.67, 8.1±0.74, 7.9±0.57, 7.6±0.70 and 8.0±0.47 for appearance, colour, taste, texture and after taste, respectively. Almost all the variants were liked by the panel members, however, mean sensory scores of MC002 and MC003 having 8g and 12g of ivy gourd powder, respectively, differed significantly (p≤0.05) from that of MCC001, and MC001.

*Methi raita*

The fourth product was *methi raita* to which fruit powder was added at 4g, 8g and 12g levels. Results of sensory evaluation revealed addition of fruit powder to be most acceptable up to 4g (MR001). It scored highest for appearance (7.3±0.67), colour (8.2±0.74), taste (8.9±0.57), texture (7.2±0.70), after taste (8.0±0.13) and overall acceptability

(8.5±1.46) and was liked very much by the panelists (Table 8, Fig 10). Addition of fruit powder improved the appearance, colour, taste, and texture of *methi raita*. This could be due to its mild salty taste, light brown colour, and granular texture. The overall acceptability scores of other variations, MR002 (8g) and MR003 (12g) differed significantly ($p \leq 0.05$) from that of MRC001 and MR001.

## CONCLUSION

Consumption of ivy gourd is an effective, long-lasting, low-cost herbal treatment for blood glucose management. Due to the seasonality, perishability, and ease of microbiological degradation of fruit, its powder can be used for developing value-added food products with high shelf-life.

Table 8 Sensory evaluation of *Methi raita* developed by incorporating ivy gourd

| Sample code | Appearance | Colour | Taste | Texture | After taste | Overall acceptability |
|---|---|---|---|---|---|---|
| RCC001 (Control) | 7.4±0.84$^{a}$ | 8.1±0.82$^{a}$ | 8.4±0.97$^{a}$ | 7.5±0.34$^{a}$ | 8.2±0.72$^{a}$ | 8.2 ± 1.53$^{a}$ |
| RC001 (4g) | 7.3±0.67$^{a}$ | 8.2±0.74$^{a}$ | 8.9±0.57$^{a}$ | 7.2±0.70$^{a}$ | 8.0±0.13$^{a}$ | 8.5 ± 1.46$^{a}$ |
| RC002 (8g) | 7.6±0.57$^{b}$ | 7.6±0.97$^{a}$ | 8.4±0.84$^{a}$ | 7.1±1.13$^{a}$ | 7.2±1.23$^{a}$ | 7.9 ± 1.57$^{b}$ |
| RC003 (12g) | 7.3±1.46$^{a}$ | 6.9±1.37$^{b}$ | 6.7±0.82$^{b}$ | 6.4±0.83$^{b}$ | 6.2±3.12$^{b}$ | 6.5 ± 1.67$^{b}$ |

Mean ± Standard Deviation

Means with different superscripts in column denote significant difference ($p \leq 0.05$)

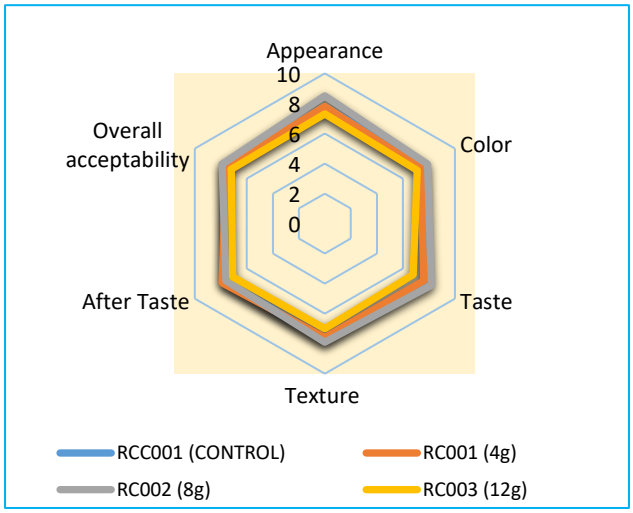


Fig 7 Mean sensory scores of *ragi* vegetable *chilla* variations

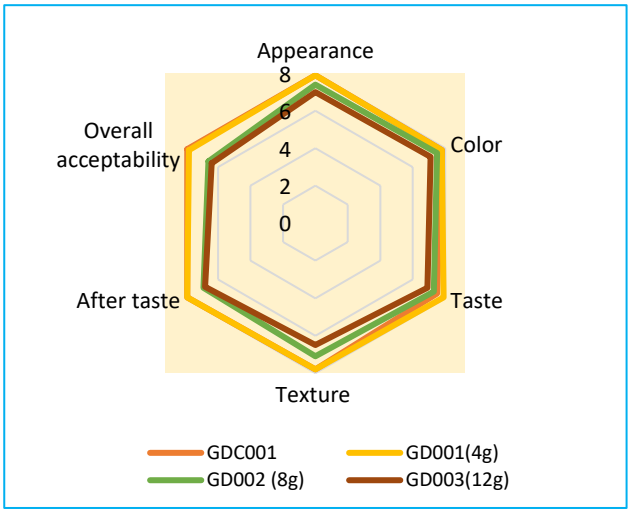


Fig 8 Mean sensory scores of garlic yogurt dip variations

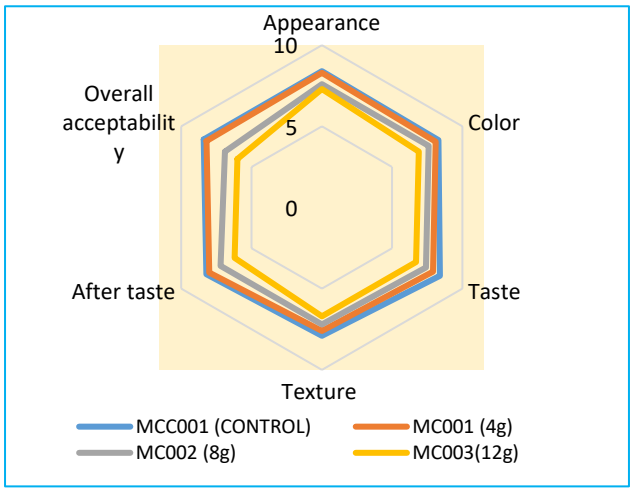


Fig 9 Mean sensory scores of *missi chapati* variations

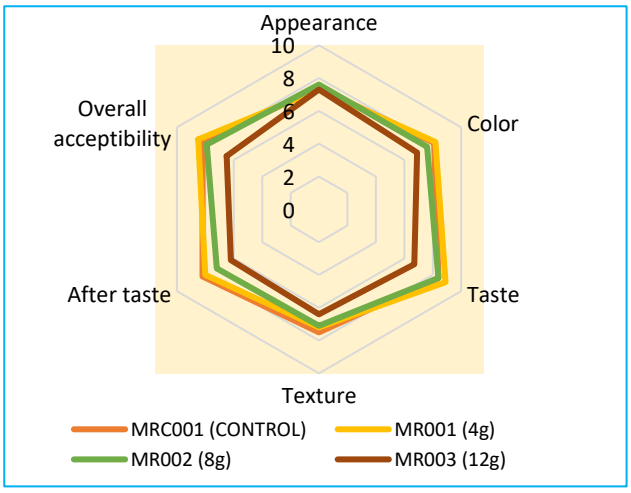


Fig 10 Mean sensory scores of *methi raita* variations

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