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FORTIFICATION OF TRADITIONAL RICE VERMICELLI WITH THE PLANT GREENS TO ENHANCE ITS NUTRITIONAL VALUE

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ABSTRACT

In present time, gaining good health is a most difficult task for everyone. At present, intake of food prepared from the leaves has expanded, yet a lot of leaves of vegetables are wasted because of lack of knowledge and information. Cauliflower and beet plant greens are rich in iron and calcium and beta carotene but they are used as animal fodder. The study was conducted to utilize these leaves to formulate product which is rich in iron, other nutrition and inexpensive. Rice flakes were also used to increase the nutritional content of product. Rice vermicelli was prepared by using iron rich powder. Iron rich powder was obtained by mixing powder of beet greens and cauliflower greens in ratio of 50:50. Refined wheat flour was used. Sample A, sample B, sample C and sample D of rice vermicelli was prepared using refined wheat flour: rice flakes: iron rich powder in the ratio of 50:45:5, 50:40:10, 50:35:15 and 50:30:20. The sensory evaluations of all products were carried out by 10 panel members on the basis of taste, colour, texture, firmness, stickiness and overall acceptability. The sample A contains 5 g of iron rich powder was highly accepted by the panel members. The least accepted sample D contains 20 g of iron rich powder. The prepared rice vermicelli was cheap in price and loaded with nutrients like iron, calcium and dietary fiber. Rice vermicelli was used to prevent certain disease like hypertension, iron deficiency anemia, diabetes and shows therapeutic effects.

Keywords: Rice vermicelli, Nutrition, Plant greens, Dietary fibers

INTRODUCTION

Green vegetables are rich in nutrients and dietary fiber. Leafy vegetables have less calories and fat but they are rich in protein, vitamins like A, K and C, carotenoids, folate, manganese. Intake of healthy diet provide good amount of micronutrients, fluid and nutrition. A healthy diet includes whole grains, vegetables, green vegetables and fruits. Plant based and animal based both are the part of a healthy (Richa. *et al*, 2017). Food is any substance which is consumed by human beings or any living organism to get energy and nutrition. Food contains carbohydrates, energy, protein, minerals and other essential nutrients which are required for the growth and maintenance of the body. Now days, a wide variety of food is produced. In animal food different type of fish and chickens are available in market. Plant foods like cereals and pulses are the main food ingredient in diet. Oil seeds are rich in unsaturated fats and intake in moderation is good for health. Seeds like sunflower, flaxseeds, rapeseeds and sesame are used in cooking (Joshi & Mathur, 2013).

Vegetables have been consumed by humanity since the starting of human enlightenment. Nature provides a variety of vegetables and these vegetables are the powerhouse of nutrition. Green leafy vegetables contain many components and these components are isolated and used to prevent diseases. Green leafy vegetables contain a large amount of anti nutritional factors which inhibit absorption of nutrition. Beetplant greens contain a significant amount of anti nutritional components like other green leafy vegetables (Banka.*et al*., 2017)

Many food products are formed by using green leafy vegetables and they used to prevent any disease. These food products help to maintain essential nutrition in the body. In Indian traditional system, vegetables are stored by using various methods. In the rural area of India, people store leafy vegetables in dry forms and use them in various recipes. In Indian traditional medicine system, beetroot is used to increase the activity of sex hormone (Towseef *et al*, 2014).

1.1 Beetroot leaves *(Beta vulgaris)*

Beetroot, one of the highly nutritious vegetables, was cultivated in ancient Middle East by Romans, Greeks, and Ancient Egyptians. Beets have an ancient Latin name which is Beta. Beta name is belong Celtic origin. Around 1400, in old English language beta name is converted into Bete. There origin belongs to sea beet. Among all green leafy vegetable, Beta vulgaris popularly known as 'Beetroot' or 'Chukandar' is rich in many nutrition and

used in many recipes. Red beet and table beet are the other name of beet root. It is mostly used as animal fodder. In middle of the 19 th century, beetroot juice was used to colored the wine. Bartolomeo platina, a gastronomist recommended intake of beetroot with garlic for treatment of garlic breath. Beetroot belongs to the Chenopodiaceous sub family which belongs to family Amaranthaceae .It is a member of subspecies Beta vulgaris subsp. Vulgaris. It is used as a medicinal plant as well as food colouring agent. As beetroot belongs to the Amaranthaceae family,it has earthy flavor and smell because of geosmin, a organic compound. Microbes present in the soil produced geosmin compound (Agic.*et al*).

Betalains and inorganic nitrate is also present in beetroot. Betalanis are water soluble pigments and contain nitrogen pigments. High amount of betalains gives red color of beetroot. Betalains are used in food industry as a coloring agent. In some industry they are used for their antioxidant property. Betalains have anti inflammantory property. Betacyanins and Betaxanthins are the main betalains which found in beta vulgaris. These pigments inhibit the human tumor cell by inhibiting the cell proliferation of these cells.

A significant amount of minerals like calcium, iron, magnesium, manganese, phosphorous, potassium, sodium, and zinc is found. Amount of protein, fiber, zinc and iron are high in beet green.Beetroot leaves are rich in nutrition than the whole beetroot. But due to the lack of knowledge and information about the nutritional quality of beetroot leaves they are still used as an animal fodder in many parts of India. Utilization of beetplant leaves helps us to control the problem of malnutrition in developing countries. Beetplant leaves for the development of various products because these leaves are highly rich in Iron, fibre, proteins, vitamins and minerals. In this study we develop an extruded product by the use of beetroot leaves powder. Beetroot greens contain good amount of carbohydrates, protein, and fiber as compared to the taproot portion of beetplant. Beetplant greens are rich in Iron, magnesium, calcium, copper. They are also rich in vitamins like A and ascorbic acid. They are rich in carotene which is a natural antioxidant and also contain retinol. The antioxidant activity of beetplant greens is higher than any green leafy vegetables Beetplant leaves contain more amount of iron than the spinach. Amount of carotenoids are also high in beetplant greens.

Like beetroot beetplant greens contain mineral inhibitors like tannin, phytates, and oxalates. These mineral inhibitors cause

problem in absorption of calcium. Amount of oxalates is higher in beetplant greens more than beetroot. According to American Dietetic Association recommendation intake of 40 -50 mg oxalate per day is not harmful for people who have kidney stones. All green leafy vegetables contain high amount of Tannin content. Among all green leafy vegetables, leaves of beetplant contain lower amount of tannin. Tannin content present in raw leaves of beetplant does not cause any harmful effect during any product formation. Like tannin, Phytate amount is low in beetplant than any green leafy vegetables. Cabbage and spinach contain more amounts of phytate content than beetplant greens. Disease like Cancer, Cardiovascular disease, Cataracts, Muscular degeneration can be reduced by the antioxidant property of beetplant greens. Hexanedioic acid is an organic acid only found in beetplant. Leaves of beetplant used as salads and sometimes they used in boiled and steamed form, give tastes like spinach. By using osmotic dehydration beetroot candies are formed which is used in bakery and ice creams etc, (Fernández *et al*., 2017).

1.2 Cauliflower greens*(Brassica oleracea var. botrytis)*

Cauliflower is one of the highly nutritious vegetables, originated in northeast Mediterranean. Cauliflower name is originated from "Cavolfiore' which means "cabbage flower". In Latin "Caulis" means stalk and "Floris" means flower. Among all green leafy vegetable, Brassica oleracea popularly known as 'cauliflower ' or in hindi it is known as 'Gobi' is rich in many nutrition and used in many recipes. Brassica oleracea also known as 'Cole' crops. The white part of cauliflower which looks like as curd is mostly used in many food recipes. Cauliflower greens are not used properly because of lack of knowledge. Now cauliflower flour is also availabl in market. Cauliflower belongs to the species 'Brassica oleracea' in genus 'Brassica', of the 'Brassicaceae' family. "Botrytis group" is the cultivator group of cauliflower. As cauliflower belongs to the 'Brassicaceae' family, it has sweet and nutty flavor with its crunchy texture and smell unpleasant because it contain sulphur compounds. Cauliflower is a annual plant which is grown by seed. Cauliflower plant has a head, edible part looks like curd in colour. Plant of cauliflower is not more than 1.5 feet tall but they have large leaves which are round in shape (Topwal *et al*., 2019).

High intake of cauliflower and cabbage by thyroid patients causes problem in iodine absorption. Cauliflower is rich in vitamins like C and K. it is used a cooked vegetable or some time it is served as salads.

According to a study additions of cauliflower greens in the diet prevent reduce the chances to anemia and increase hemoglobin level in blood. Cauliflower greens contain good amount of calcium and iron and fibre. Because of its good calcium and iron content it helps in formation and maintenance of bones. High amount of fibre helps in digestion and better functioning of gut.

1.3 Rice flakes *(Oryza sativa)*

Rice flakes are the flattened rice. These flakes are flat in shape and dry in weight. These are the native of Indian subcontinent. For the formation of rice flakes rice is semiboiled and this process is known as parboiling (Suma.*et al.,* 2007). After the parboiling of rice the next step is flattening of rice. Rice flakes starts to swell as they start to absorb liquid during cooking. They easily absorb water, milk or any other liquid. It is also known as "beaten rice." Normal rice flakes are four times thick then rice flakes (Sharma and Surampalli, 2017). These rice flakes are more highly digestible. In India, Nepal, Bangladesh rice flakes are highly consumed. They are easy to prepare and used for long term consumption. Rice flakes are known by different names:

Kannada – Avalakki
Gujarati – Pauaa/Paunva
Rajasthani – Poya
Odia – Chuda
Telugu – Atukulu
Tamil – Aval
Malayalam – Aval
Bihar and Jharkhand – Chiura
Marathi – Pohe
Hindi – Pauwa
Bengali – Chira
Konkani – Phovi

Products enriched with rice flakes powder contain a good amount of iron. According to the results of sensory evaluation the products enrich with 15 % rice flakes powder was highly acceptable. The enriched ladoo contains 8.92±0.07 and sev contain 5.31±0.27 more iron than control group and due to their high iron content they can be used to prevent iron deficiency disease (Rana *et al*., 2019).

Suma *et al*., 2007 find out the level of iron and calcium in thin to thick flakes. The presence of phytin phosphorus and dietary fiber in rice flakes associated with the absorption of iron and calcium in body.

Jyoti Sinha & Dubey, 2015 prepare the rice flakes mixed with herbs to improve the nutritional quality of rice flakes. It improves the calcium and iron content of the rice flakes.

Aim

In this study we develop a value based product using the powder of cauliflower greens, beet greens and rice flakes. The

main aim of this study was to formulate a product which is rich in iron to prevent iron deficiency disease. This product is formulated using less utilized leaves of beetroot and cauliflower. This product is less expensive and easy to prepare and cook. This value based product is rich in many nutrients along with iron and prevent from many disease.

MATERIAL AND METHODS

The present study was conducted in department 'Dietetics & Applied Nutrition' faculty 'Amity Medical School' of 'Amity University Haryana'. The main aim of the study was to formulate a Iron Rich Vermicelli to prevent iron deficiency disease.

3.1 Processing of All Ingredients:

3.1.1 Processing of Beetroot Leaves

3.1.1.1 Collection of beet leaves: Fresh beetroot leaves were collected from the near fields. Leaves with bulb and wrinkled yellow skin were discarded because they were dehydrated. Leaves green colour without bulb was selected. Collected leaves were long to medium in size with enough maturity.

3.1.1.2 Washing of leaves: Diet, soil and dust were present on the surface of collected leaves. To remove the dirt and soil leaves were washed under the running tab water. These washed leaves were collected in a utensil.

3.1.1.3 Blanching of beet leaves: Washed leaves were blanched for 2 minutes. The blanching was carried out by putting leaves in hot water for 2 minutes and then placed them in cold water immediately. By placing leaves in cold water remove the excess heat from the blanched leaves. Blanching increase the moisture, fat, crude fiber and beta carotene amount in leaves. Bulk density, ratio of rehydration, repose angle of leaves was affected by blanching. Blanching decrease the protein, carbohydrates and ash amount of leaves.

3.1.1.4 Drying of leaves: Blanching leaves were placed on a tissue paper. Tissue papers absorb the excess water from the surface of the leaves. Leaves were dried into sunlight for 2 days.

3.1.1.5 Powder of leaves: After drying, leaves were reduced into powder using grinders and the powder was stored into labeled air tight containers.

3.1.2 Processing of Cauliflower Greens

3.1.2.1 Collection of cauliflower greens: Cauliflower greens were collected from a nearby market.

3.1.2.2 Washing of cauliflower greens: Cauliflower greens were washed under running tap water to remove dirt and dust for their surface.

3.1.2.3 Cutting into pieces: Greens were cut into small pieces because it was easy to dry small pieces than larger ones. These

small pieces of cauliflower were washed again under running tap water.

3.1.2.4 Drying: Pieces were dried into sunlight for 3 days.

3.1.2.5 Powder of greens: Dried pieces of cauliflower greens were reduced into powder using grinders and powder stored in air tight containers.

3.1.3 Processing of Rice Flakes:

3.1.3.1 Collection of rice flakes: Rice flakes of good variety were purchased from a near market.

3.1.3.2 Powder of rice flakes: Rice flakes were converting into powder by using grinders.

3.2 Formulation of Vermicelli:

Powder of cauliflower greens, beet leaves and rice flakes was used to prepare a product common in India. Vermicelli commonly used in all Indian houses was prepared using above ingredients was used for the completion of study. Refined wheat flour was used for the binding of vermicelli. An iron rich powder was prepared in amount of 100 gram by adding cauliflower greens powder and beetroot leaves powder in the ratio of 50:50.

3.2.1 Variation in samples of vermicelli:

Four samples were prepared and each sample was of 100 gram.

Ingredients	Sample A	Sample B	Sample C	Sample D
Rice flakes powder	45g	40g	35g	30
Iron rich powder	5g	10g	15g	20g
Refined wheat flour	50g	50g	50g	50g
Total	100 g	100 g	100g	100g

3.2.2 Preparation of dough:

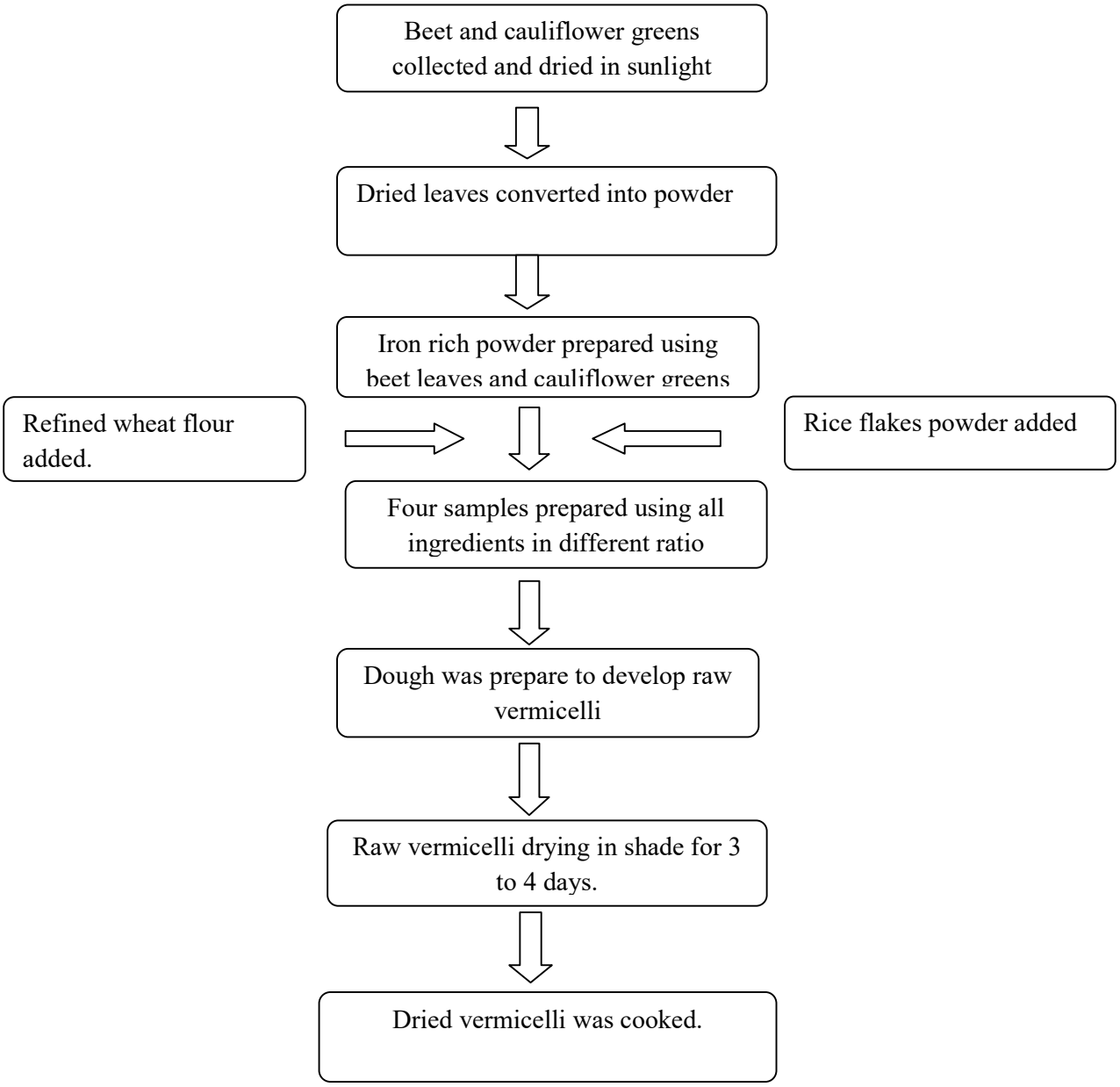
All samples were prepared separately with same procedure. All ingredients were mixed properly to get consistent dough. Less 50 ml water was used for the preparation of dough. To prepare vermicelli dough should be little hard in consistency.

3.3.3 Procedure for preparation of vermicelli:

- Uncooked and raw vermicelli was prepared by hands without using any machine.
- A little amount of ghee was used at hands because it makes dough less sticky and it improve the preparation.
- All samples of raw vermicelli were dried under shade for 3 to 4 days.
- Dried vermicelli was used for cooking.
- Each sample was cooked separately.
- For cooking, 1 tablespoon oil was heated in a non stick pen.
- Half teaspoon of cumin seeds was added.

- 50 gram of chopped onion and tomato were added.
- A little amount of turmeric, red chili powder and salt was added.
- After 2 to 3 minutes, raw vermicelli was put into pen.
- Less than half glass of water added into pen and covered for few minutes.
- Cooked vermicelli was put into a plate.
- Each sample was prepared with same procedure.

3.3.4 Flow chart of preparation of vermicelli:



3.3.5. Images of processing preparing vermicelli:

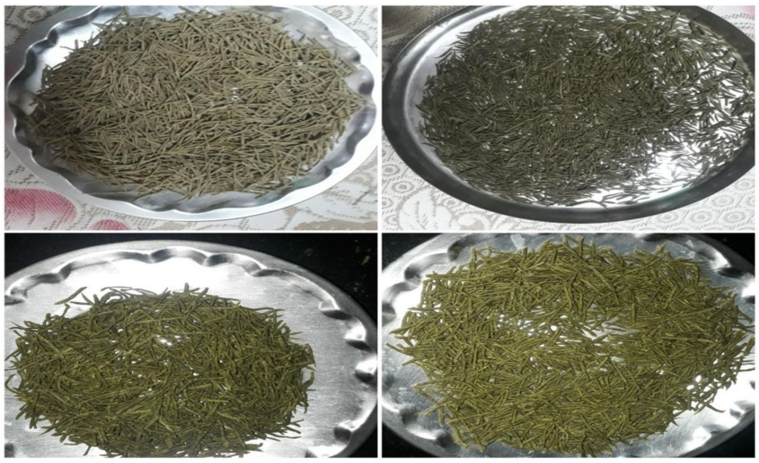
(Beetroot Plant)

(Washed leaves)

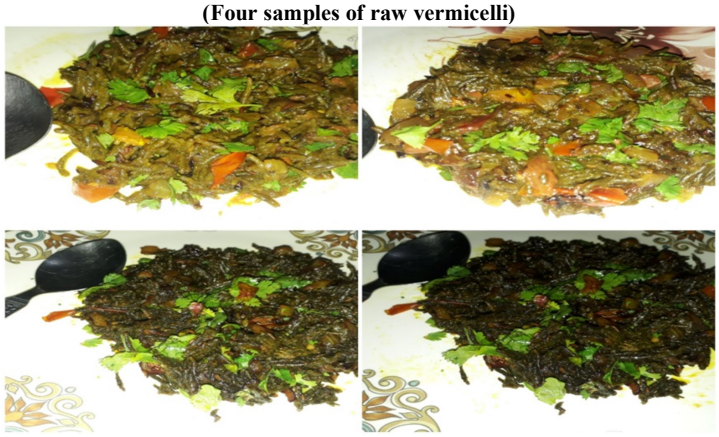
(Fresh and dried cauliflowers)

(Blanched and dried leaves of cauliflower)

(Powder of cauliflower greens, beet leaves, Rice flakes and refined wheat flour)



(Four samples of raw vermicelli)



(The cooked four samples of vermicelli)

SENSORY EVALUATION

Sensory evaluation requires a proper method of evaluation, a team of panel members, data analysis and screening of panel members.

4.1 Requirements for Sensory Evaluation:

4.1.1 Room for sensory evaluation:

1. Table – Round tables were used for the in the rooms.
2. Booth – Sensory booths provide helps in evaluation and avoid bias and disturbance.
3. There should be no foreign odor. Foreign odors cause problem in evaluation the odor of products.
4. There should be no noise in room to avoid distraction during evaluation. At the time of sensory evaluation a panelist requires silence to avoid any distraction and problem in evaluation of products.
5. Room should be clean and free from infection. A clean free keeps the mind calm and
6. Room temperature, moisture, and humidity should be under control.
7. Facility of ventilation should be present in room. Proper ventilation system maintains the quality of air in rooms.

8. Testing area where food evaluated is different from the food preparation area.

4.1.2 Bodily set up for sensory evaluation:

Booth called as sensory booth was used for the sensory evaluation of formulated product. The main aim of these sensory booths was to increase the sensitivity of panel members and reduce the bias and factors which were not present in product. White fluorescent light and air conditioner with proper temperature was used in sensory booth for the evaluation.

4.1.3 Standards for appointing panel members:

Selected panel members for sensory evaluation of formulated products were male and female of age 20 to 35 years. These selected panel members were healthy and they had no defects like color blindness, taste blindness and odor blindness. If a selected panel member had any above defects it causes problem in sensory evaluation. The main objective of the selection of panel members was to avoid any defects in members and maximize the sensitivity level of members to reduce bias and improve the sensory evaluation. Some of the factors like sensitivity, ability of judgments without others influence, interest and curiosity in evaluation of product, learning capability, power of concentration, level of motivation and enthusiasm for participation in evaluation of formulated product were considered during selection of panel members.

4.1.4 Screening of panel members:

Screening of panel members was done on the basis of their

- Ability to find out the difference between samples,
- Ability to differentiate all odors and flavors.
- Ability to elaborate their experience of evaluation in a clear way.

4.1.5 Sensory scale for evaluation:

Scale based on texture, colour, taste, firmness, stickiness and over all acceptability was used for the sensory evaluation of all samples.

4.1.6 Sample presentation:

All samples of product were served in plates. Each plate was labeled with numbers for presentation of samples. A glass of water also provided with samples for cleansing of taste buds. Water cleans the taste buds which helps in better and improved tasting of samples. All samples were served in a random order to avoid bias during sensory evaluation of product.

4.2 Sensory evaluation:

4.2.1 Table of Sample A:

S. No.	Taste	Colour	Texture	Firmness	Stickiness	Over acceptability
1.	10	9	9	10	10	9
2.	10	9	9	9	10	9
3.	7	7	9	10	10	9
4.	8	10	9	7	9	9
5.	10	10	10	10	10	10
6.	10	9	10	10	10	10
7.	10	9	9	10	9	9
8.	9	8	10	10	9	10
9.	7	8	9	10	9	10
10.	10	8	10	9	9	9
Total	91	97	94	95	95	94
Mean	9.1	9.7	9.4	9.5	9.5	9.4
Standard deviation	1.286684	0.674949	0.516398	2.915476	0.527046	0.516398

4.2.2 Table of Sample B:

S. No.	Taste	Colour	Texture	Firmness	Stickiness	Over acceptability
1.	7	9	10	8	8	7
2.	8	9	8	7	9	9
3.	9	7	9	6	10	9
4.	9	10	9	10	9	10
5.	9	10	10	10	9	10
6.	10	9	9	9	10	9
7.	10	9	10	10	10	10
8.	9	8	10	7	10	7
9.	9	8	10	10	9	10
10.	8	8	9	8	7	8
Total	88	87	94	85	91	89
Mean	8.8	8.7	9.4	8.5	9.1	8.9
Standard deviation	0.918937	0.948683	0.6992059	1.509231	0.994429	1.197219

4.2.3 Table for Sample C:

S. No.	Taste	Colour	Texture	Firmness	Stickiness	Over acceptability
1.	8	9	9	8	10	9
2.	8	8	8	8	9	9
3.	10	7	10	9	8	10
4.	10	9	10	8	9	7
5.	10	9	9	10	9	10
6.	10	9	10	10	9	10
7.	9	8	10	10	10	9
8.	9	9	9	8	8	9
9.	10	7	10	7	6	10
10.	7	9	9	10	7	8
Total	91	84	94	88	85	91
Mean	9.1	8.4	9.4	8.8	8.5	9.1
Standard deviation	1.100505	1.686548	0.6992059	1.135292	1.269296	0.994429

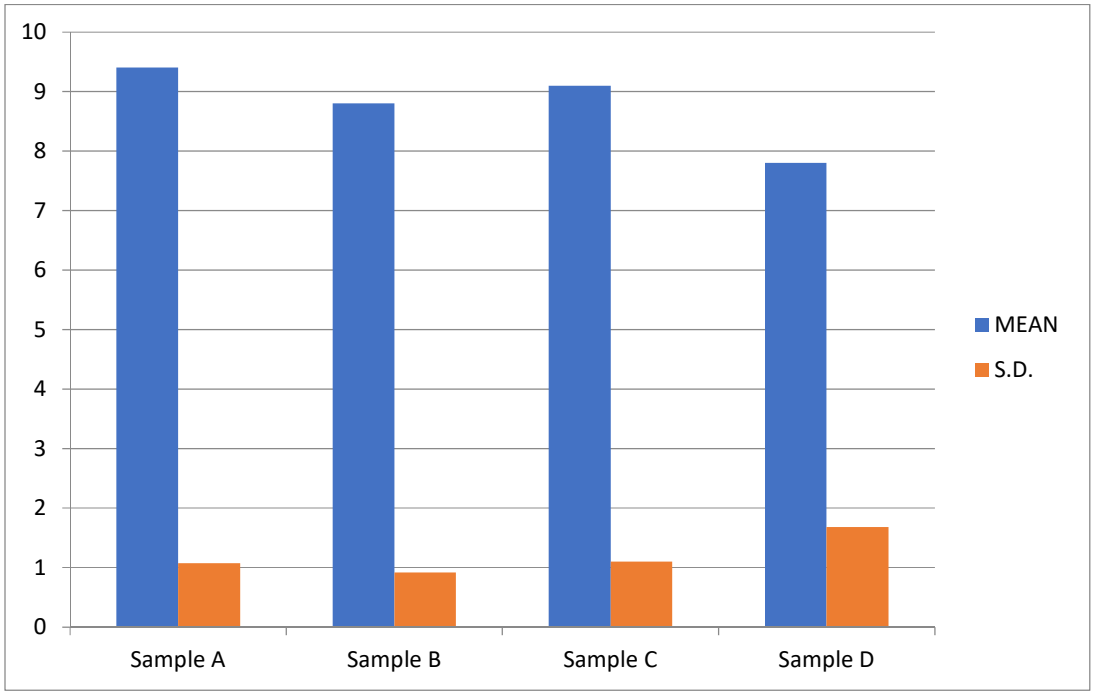
4.2.4 Table for Sample D:

S. No.	Taste	Colour	Texture	Firmness	Stickiness	Over acceptability
1.	9	7	7	9	9	9
2.	5	5	5	5	5	5
3.	8	8	9	7	8	8
4.	9	7	6	9	8	9
5.	9	6	10	10	9	10
6.	8	7	10	10	9	10
7.	8	9	8	9	9	8
8.	5	5	5	5	5	5
9.	10	9	7	6	4	7

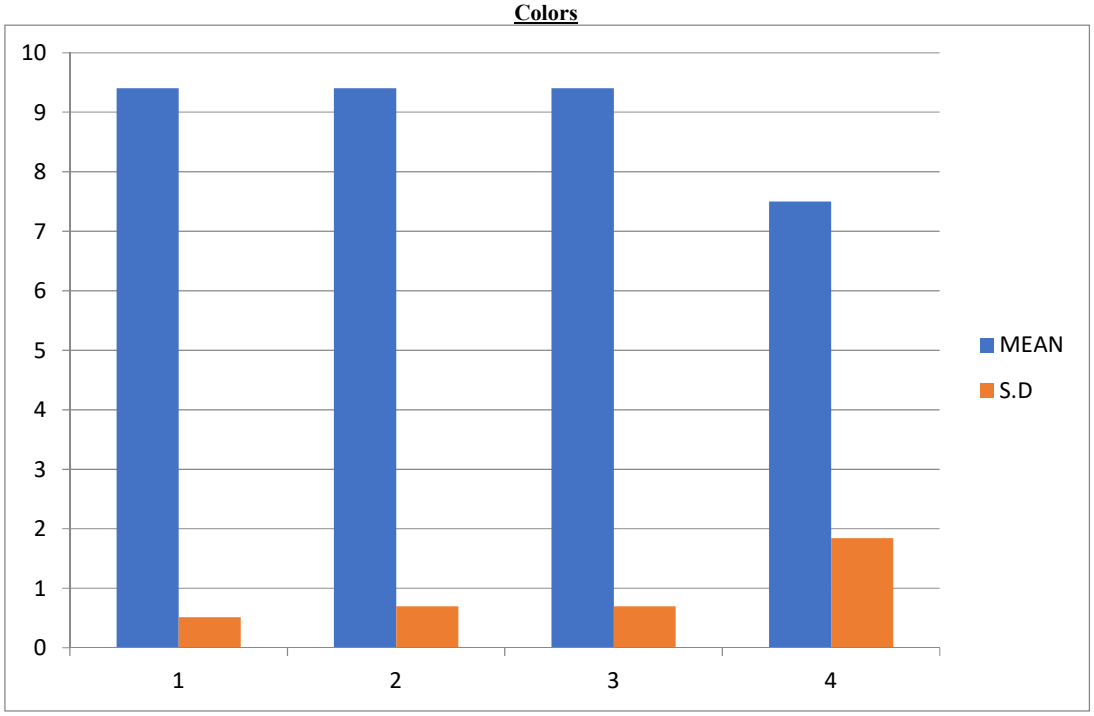
10.	**7**	**9**	**8**	**10**	**7**	**7**
Total	**78**	**72**	**75**	**80**	**73**	**78**
Mean	**7.8**	**7.2**	**7.5**	**8**	**7.3**	**7.8**
Standard deviation	**1.686548**	**1.549193**	**1.840894**	**2.054805**	**1.946507**	**1.813529**

4.3 Graphical representation of sensory evaluation:

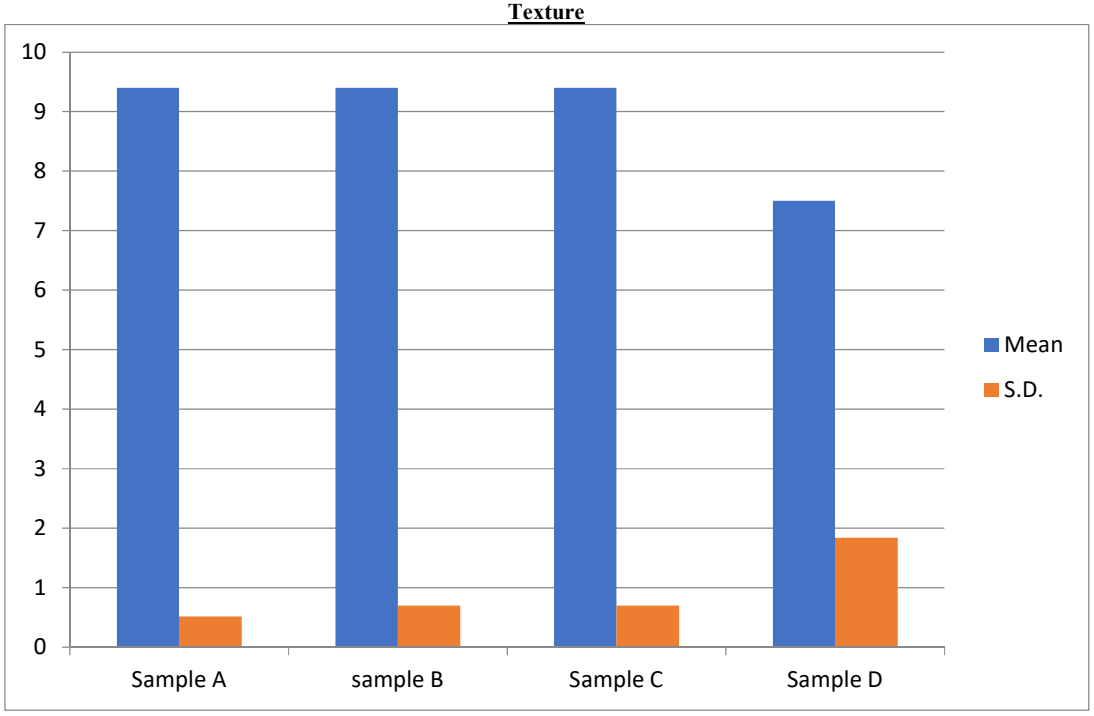
Taste -



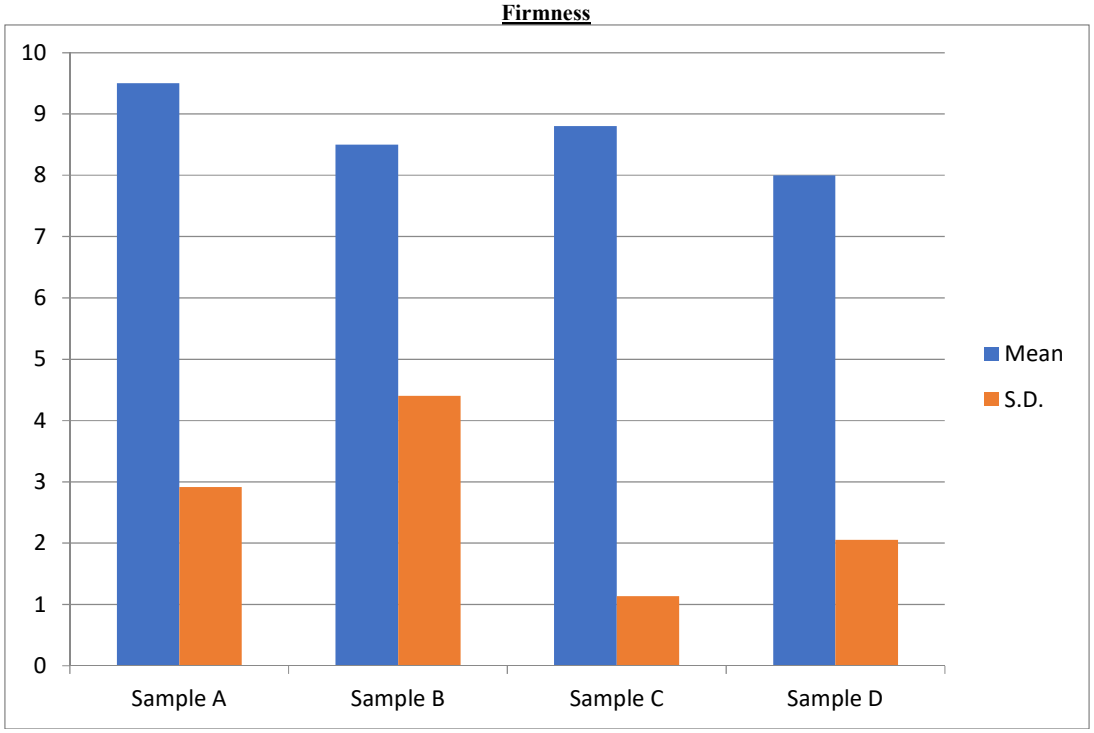
Colors

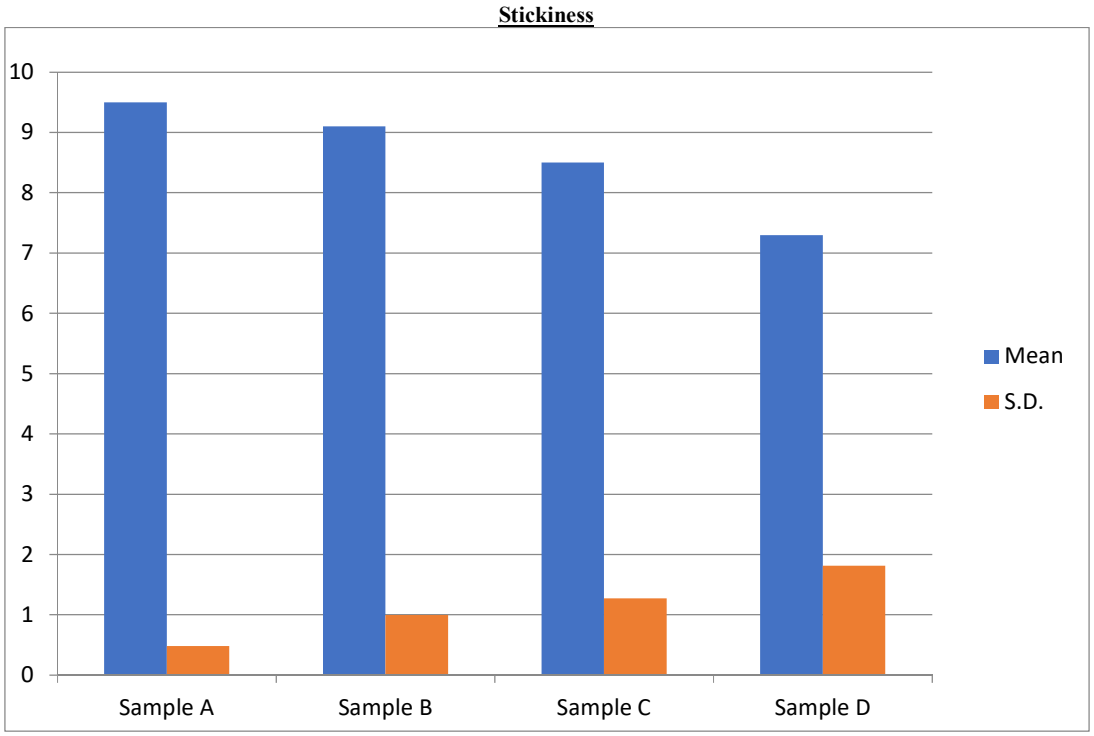


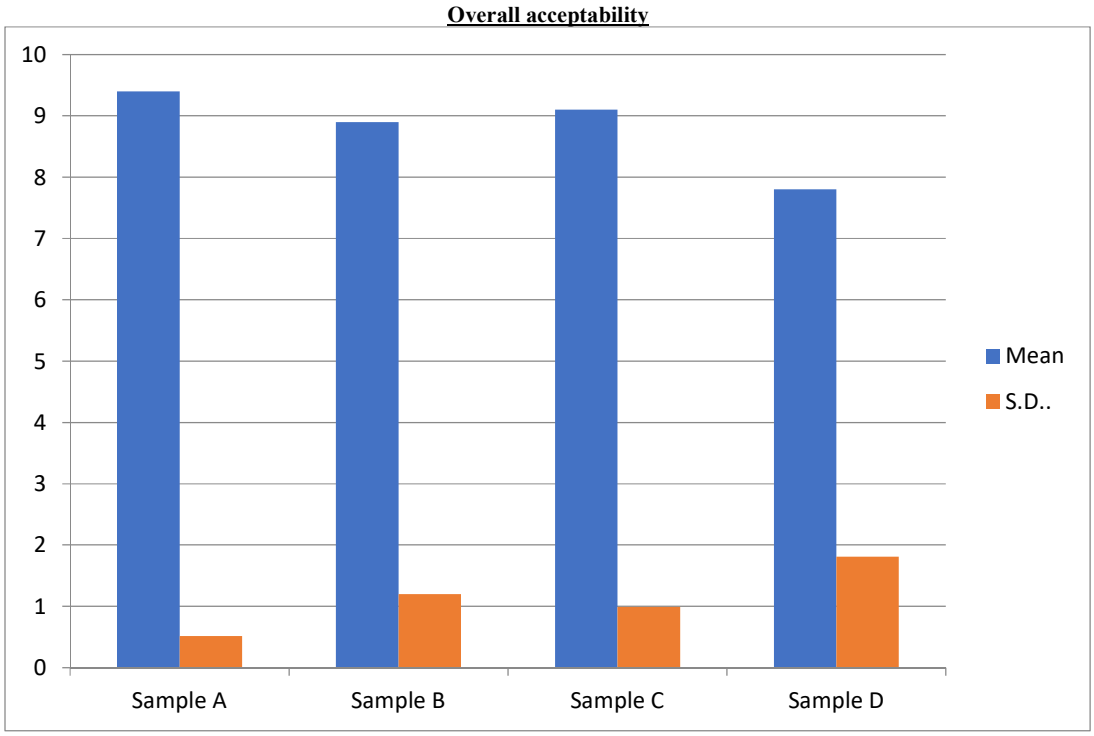
Texture



Firmness




Stickiness
10
9
8
7
6
5
4
3
2
1
0
Sample A
Sample B
Sample C
Sample D
Mean
S.D.


Overall acceptability
10
9
8
7
6
5
4
3
2
1
0
Sample A
Sample B
Sample C
Sample D
Mean
S.D..

RESULT AND DISCUSSION

5.1.1 Discussion:

The result based on the above sensory evaluation indicates and analysis the various parameters. The above graph and tables of all samples indicates that all samples were accepted in terms of taste but sample A was highly accepted by the panel members. Sample D was less accepted. Sample A contains 5 g of iron rich powder per 100 gram and highly accepted in terms of taste. The graph indicates that iron rich powder was inversely proportional to taste. High amount of iron rich powder lowers the rate of taste. According to graph color of all products were slightly accepted but sample A was highly accepted in terms of colors. Sample C and sample B were well accepted but sample D was less acceptability in terms of colors. Sample A was light green on color because it contains only 5 g of powder but sample D had 20 g powder of greens which gives dark green color to product. The uncooked vermicelli of sample A was attractive in color and different from every sample because of its light color. The graph shows that sample A was highly accepted in terms of texture which was followed by sample B and sample C. Sample D was less accepted by the panel members during sensory evaluation. It was also hard to prepare vermicelli from the dough of sample D which contains 20 g powder. Sample A was highly accepted on the basis of firmness. Sample C was more accepted than sample B. Sample D shows fewer score on the basis of firmness in graph. The high amount of greens powders in sample D causes instability in product. On the basis of stickiness sample A got high scores during sensory evaluation. Sample B and sample C were well accepted on the basis of stickiness. Sample D shows high amount of stickiness and less accepted by the panel members. Sample A was high overall acceptability on the basis of texture, taste and color. Sample A had good color and better taste among all the samples. Texture and firmness of the sample was maintained after the cooking. Sample B was less accepted than sample A and sample C on the basis of firmness, taste, texture and color and had less overall acceptability. Sample D got less overall acceptability on the basis of texture, color, taste, firmness and stickiness among all samples.

CONCLUSION

In the present study an effort was made to a product which is rich in iron and prepared easily from the less utilized greens of vegetables. Powder of beet plant leaves, cauliflower greens and rice flakes was used to develop iron rich vermicelli. Greens of beet plant and cauliflower were wasted due to lack of knowledge. The greens were

loaded with nutrition content as well as with anti nutritional content. To remove anti nutritional factors blanching method was used. This Vermicelli is an Indian traditional product and easy to prepare and cook. It is concluded that vermicelli incorporated with 5g gram iron rich powder are highly accepted in the term of taste, texture, colour, firmness, stickiness and overall acceptability. The nutritive value of vermicelli was also increased with sensory characteristics. Formulated vermicelli was rich in iron, calcium, dietary fiber which increases the level of blood and prevents from many diseases. Using greens of beet plant, cauliflower and rice flakes in preparation decrease the wastage and improve the quality of diet.

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