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Nutritional and Sensory Evaluation of Low-Cost Iron Rich Recipes Fortified with Garden Cress Seeds (*Lepidium Sativum*)

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Abstract: ***Seeds are versatile ingredient, which can be used to enhance texture and add burst of micro nutrients. Among all known seeds, Garden cress seed (Gcs) is an unpopular and often referred as Forgotten Superfood as general public is unaware of its inexpensiveness and nutritive potential which is yet not utilised to its fullest. Gcs comes with hampered number of micronutrients, 100 gm of Gcs contain 723mg phosphorus, 377 mg calcium and 100 mg iron.***

This study focuses on the development of low-cost iron rich recipes using Gcs. The two recipes developed were Fruit Leather (FL) and Instant Sattu premix drink (SD). Three variants for each recipe were created, as FL1, FL2, FL3 and SD1, SD2, SD3; with different level of fortification, which was first sensory analysed, to estimate the most accepted variants. The best accepted variant FL3 and SD2 was not significant (p>0.05) different in other attributes. Nutrients like iron. protein, carbohydrate, and fibre were analysed. FL cover 11.25% DV of total iron requirement, SD comprehend 37.50%. Both the product contains beneficial amount of protein, carbohydrates and fibre, which will aid both adolescence and people of older age. The cost of the products was relatively lower than the market price, total production cost of FL was 12.5 Rs/100gm and SD cost for 18.5 Rs/100 gm. Both the products are worthwhile as they provide such vital nutrients in abundant on lower cost.

Keywords: Garden cress seed (Gcs), Forgotten Superfood, fortification, low-cost iron rich recipes, Fruit Leather (FL), Instant Sattu premix drink (SD).

I. INTRODUCTION

Garden Cress Seed (Gcs) is one of the “Forgotten Superfood”. Gcs has different names in several parts of India. Commonly called as Aliv or Halim Seeds. The good thing about Gsc is not fully known or celebrated (Diwekar, 2016). Gcs are red in colour, small in size, oval in shape, pointed and triangular at one end (Image no. 1). Gcs looks almost like til seeds. On soaking Gcs get swelled and covered in transparent mucilage (Bigoniya, 2011); (Najeeb-ur-Rehmana, 2011). Garden cress seed (Gcs) is extremely popular in Sothern part as compared to Northern and central parts of the country. In South India Gcs is employed for postpartum remedies, increases milk production (Alshawabkeh, 2013), as Gcs helps to regulate hormones and have anti-diabetic effects. (Divanji M, 2012). The current epidemic that affects the most women is PCOD, in which testosterone levels are elevated, in turn result in acne, pimples, and baldness. These problems can be managed by introducing Gcs in daily diet. The seeds are not just regarded as a post-partum essential but as a natural aphrodisiac because it has properties that mimic oestrogen (Paswan, 2017). Gcs even have anti-oxidants and hemoprotective effects and is excellent source of iron for all womankind. (Diwekar, 2016); (Dashora & Choudhary, 2016); (Ankita Tandon, 2016).

A famous celebrity nutritionist Rujuta Diwekar mentioned Gcs as “Beauty Pill” because it contains good amount of vitamin A and E. Gcs also have Sulforaphane, a nutrient which provides the skin even tone, and reduce patches, gives brightness and other essential fatty acids like linoleic and Arachidic which benefit skin. In her book Indian Superfoods, she also added that Gcs is definitely a superfood because it possesses tons of micro nutrients, such as iron, folic acid, calcium, phosphorus.(Devi, 2015); (Jain, 2016); (Diwekar, 2016).(Table no. 1). Gcs is rich in many phytochemicals, which adds to Gcs therapeutics properties. (Kirtikar, 1935). Since Vedic era Garden cress seed (Gcs) is employed for medicinal purposes, for the treatment of various diseases including bronchitis, asthma, (Paranjape AN, 2006), paste of Gcs is applied in rheumatic joints which relieves pain and inflammation. (Nita D.Raval, 2009); (Sharma S. , 2011); (Falana, 2014); (Snehal Doke, 2014). Studies have shown that the leaves and seeds of Gcs have anti-inflammatory effects, the Gcs paste mixed with lemon juice can reduce inflammation and rheumatic pain, during ancient times Gcs paste was used for healing bone fracturedue and hepato-protective effect due to the presence of alkaloids, flavonoids, cyanogenic glycosides (traces), triterpens, tannins, glucosinolates and sterols (Paranjape AN, 2006); (Sharma S. N., 2011); (Falana, 2014); (Fatma h Alharbi, 2021).

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Table no. 1 Nutritive value of Garden Cress seed per 100g *(Medindia, n.d.)*

Energy	454 Kcal
Moisture	3 gm
Protein	25 gm
Fat	24 gm
Fibre	8 gm
Carbohydrates	33 gm
Calcium	377mg
Phosphorous	723 mg
Iron	100 mg



Image no. 1 Garden cress seeds

II. METHODOLOGY

Two products with three variants were prepared, the process was divided into 4 phases

A. Phase 1- Procurment of Garden Cress Seed

Garden cress seed with high quality and reasonable price was collected from local market. The seeds were handpicked for removal of any physical impurities, rinsed to remove any dirt, air dried, roasted to alter the taste and grinded to make coarse powder

B. Phase 2- Development Of Product

The two GCS fortified products were developed.

1) Fruit Leather (Product code - **FL**) - Three different variations of fruit leather were developed by using papaya- **FL1** fortified with 5% of garden cress seeds, artificial colour and flavour were added. Whereas **FL2** was also fortified with 5% of garden cress seeds, for natural colouring beetroot were add 10% of total papaya pulp and **FL3** also contain pure papaya pulp with no added colour of flavours and with same percentage of Garden cress seeds.

2) Sattu Primix Drink (Product code - **SD**) - Three different variations of instant sattu premix were developed by using channa sattu and sundried vegetables- **SD1** fortified with 05% of Gcs, sundried mint, beetroot, chillies, corianders, and carrots, were added. Whereas **SD2** was also fortified with 10% of Gcs, sundried mint, beetroot, chillies, corianders, and carrots and **SD3** contain 15% of Gcs, sundried mint, beetroot, chillies, corianders, and carrots.

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C. Phase 3- Sensory Evaluation

1) Sample area- The study was conducted in Lucknow city.
2) Sample composite/ type- Random sampling; both male and female of different age groups were selected for sensory evaluation.
3) Period of study- The study was conducted in the time period April- May 2022.
4) Sample size- Total samples sample size was 50 including 10 trained, 20 semi-trained and 20 untrained evaluators.

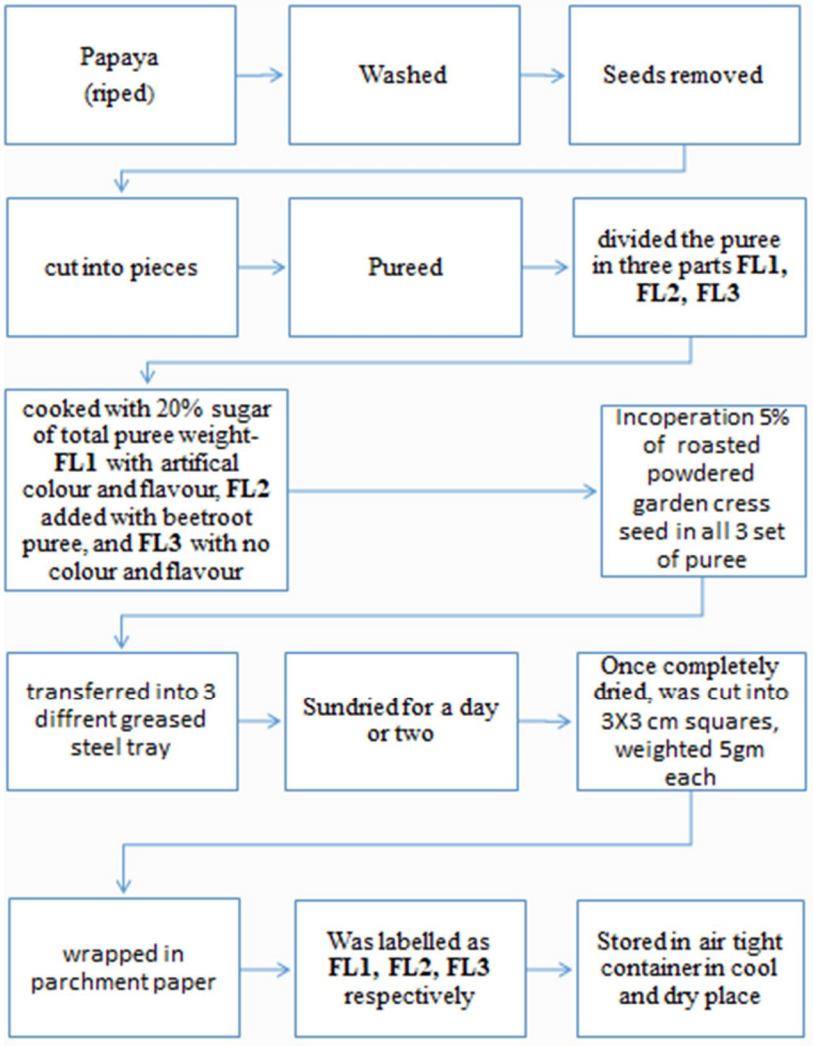
a) Statical Analysis: The two hypotheses were formulated- Null Hypothesis (H_0) – There is no significant difference between the variation of food products. Alternative Hypothesis (H_A)– There is significant difference between the variation of food products. For this 2-way analysis of variances (2-way ANOVA), Mean and Standard deviation was performed.

D. Phase 4 – Nutritive Analysis

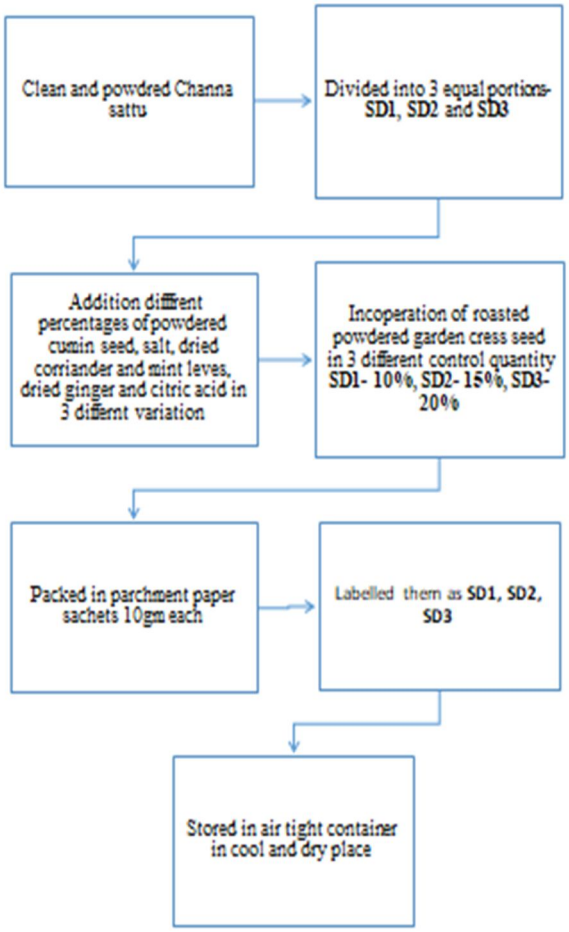
Through different laboratory methods, iron, and proximate analysis (carbohydrates, protein, moisture, ash) was conducted by CytoGene Research and Development Laboratory Sahara States, Jankipuram, Lucknow.

1) Cost Estimation: Cost of most accepted variants of both the products were estimated.

Flow chart for development of product A- Fruit Leather



Flow chart for development of product B- Instant Premix Sattu Drink



III. RESULTS AND DISCUSSION

A. Sensory Evaluation

Mean of colour, appearance, taste, texture and overall acceptability was calculated for each variant of both the samples. For fruit leather FL3 which was pure papaya pulp with 5% fortification was most accepted one, among the variants of instant sattu premix drink the most liked was SD2 with 10% fortification of Gcs and 10% added dried vegetables score (Table no. 2), (Table no. 3).

1) Mean Score For Sensory Evaluation Of Fruit Leather (FL)

Characteristics	FL1	FL2	FL3
Colour	6.65	7.68	7.64
Appearance	6.88	7.60	8.56
Taste	6.58	7.56	8.72
Texture	6.70	7.56	8.90
Overall acceptability	6.32	7.28	8.56

Table no. 2 Mean for sensory evaluation of fruit leather

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2) Mean Score For Sensory Evaluation Of Instant Sattu Premix Drink (SD)

Characteristics	SD1	SD2	SD3
Colour	5.88	7.26	6.50
Appearance	6.42	7.78	6.78
Taste	6.84	8.08	6.88
Texture	6.92	7.92	6.62
Overall acceptability	6.92	8.44	7.22

Table no. 3 Mean for sensory evaluation of sattu premix drink

B. 2 Way Anova

ANOVA for FL- From Table no. 4, the F-value for colour, appearance, taste, texture and overall acceptability is high and p-value is <0.001, hence the null hypotheses is rejected, and it is proved that there is a significant difference in colour, appearance, taste, texture and overall acceptability among all three variants of fruit leather .ANOVA for SD- From Table no. 5, the F-value for colour, appearance, taste, texture and overall acceptability is high and p-value is <0.001, hence the null hypotheses is rejected, and it is proved that there is a significant difference in colour, appearance, taste, texture and overall acceptability among all three varients of instant sattu premix drink (Table no. 4), (Table no. 5).

Anova Table For Fruit Leather

		Sum of square	df	Mean Square	F-Value	P-Value (sig)
Colour	Between Groups	40.373	2	20.187	18.015	<.001
	Within Groups	164.720	147	1.121		
	Total	205.093	149			
Appearance	Between Groups	74.293	2	34.147	61.327	<.001
	Within Groups	89.049	147	.606		
	Total	163.333	149			
Taste	Between Groups	114.760	2	57.380	104.697	<.001
	Within Groups	80.580	147	.548		
	Total	195.340	149			
Texture	Between Groups	122.920	2	61.460	123.222	<.001
	Within Groups	73.320	147	.499		
	Total	196.240	149			
Overall Acceptability	Between Groups	126.293	2	63.147	86.526	<.001
	Within Groups	107.280	147	.730		
	Total	233.573	149			

Table no. 4 ANOVA for Fruit Leather

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Anova Table For Instant Sattu Premix Drink

		Sum of square	df	Mean Square	F-Value	P-Value (sig)
Colour	Between Groups	47.773	2	23.887	16.454	<.001
	Within Groups	213.400	147	1.452		
	Total	261.173	149			
Appearance	Between Groups	49.563	2	24.827	19.906	<.001
	Within Groups	183.340	147	1.247		
	Total	232.993	149			
Taste	Between Groups	49.653	2	24.827	23.748	<.001
	Within Groups	153.680	147	1.045		
	Total	203.333	149			
Texture	Between Groups	46.333	2	23.267	18.198	<.001
	Within Groups	187.140	147	1.273		
	Total	233.473	149			
Overall Acceptability	Between Groups	64.813	2	32.407	32.062	<.001
	Within Groups	148.580	147	1.011		
	Total	213.393	149			

Table no. 5 ANOVA for Instant Sattu premix drink

C. Nutritive Analysis And Cost Estimation

The foremost consideration of this study was to produce low cost, iron rich product and to evaluate its iron content. The iron, proximate content and Daily Value% (DV%) was estimated and the results are- 100gm of Fruit Leathers possess 3.6 mg iron. The DV% was estimated against highest iron requirement i.e., 32 mg/day for adolescent girls of age 16- 18 years. The DV% for iron of 100gm Fruit Leather was 11.25%. The result of proximate analysis was up to par, The moisture content for 100 gm of Fruit Leather is 18.40%, one can estimate contamination rate by moisture percentage as it is directly proportional to each other, higher the

moisture, higher will be contamination. The ash content is 20%, higher the ash content, higher will be mineral content. The dietary fibre content is 8.94%, according to RDA fibre requirement is 40 gm/day for 2000 Kcal according to that DV% of 100 gm FL provide 22.35% fibre. whereas carbohydrates are 30 gm/ 100 gm of sample, RDA for adolescence is 130 gm/day according to which the DV% for CHO of FL is 23.07%. The protein content is 0.88gm, the highest adolescent protein RDA is 55 gm/ day according to which 100 gm FL provide 1.6% DV% and the energy content of 100 gm of FL is 288.28 kcal energy. The product developed just not provide iron but also advantageous amount of fibre and carbohydrates, which will provide satiety as the product can be use as snacks to relief hunger between meal. Also the leather are so designed that are convenient to be carried as snacks in school lunch box, easy to consume (Table no. 6)

Same was with Instant Sattu premix drink, 100 gm of SD contains 12.1 mg iron, according to this the DV% of iron for 100 gm SD was 37.5%. The moisture content for 100 gm of instant Sattu premix is 03%, the contamination rate will also be lower as it has low moisture content. The ash content is 03% for 100 gm of Instant Sattu premix, higher the ash content, higher will be mineral content. The fibre content is 16.03%, RDA fibre requirement is 40 gm/day for 2000 Kcal according to that DV% of 100 gm of SD is 40.075% whereas carbohydrates is 56 gm/ 100 gm of SD, RDA for adolescence is 130 gm/day according to which the DV% for CHO is 43.07%. The protein content is 20 gm for 100 gm of Instant Sattu premix, the highest adolescent protein RDA is 55 gm/ day according to which 100 gm SD provide 36% DV. And the energy SD provide is 160 kcal energy.SD provide enormous amount of iron, as well as protein. Good protein provides healthy muscle mass, good growth, the product SD can be beneficial to adolescent, and old age, because protein requirement is high during these stages (table no 7).

The total production cost of 100 gm of Fruit Leather was 11.05 Rs, while on adding packing charges, it cost for 12.5 Rs. 100 gm of Instant Sattu premix cost for 17.5 Rs, while adding packaging, it cost for 18.5 Rs.

Table no. 6 DV% of Fruit Leather

DV% FOR FRUIT LEATHER			
Nutrients*	RDA 2020	Product Provides	DV%
Iron	32 mg/day	3.6 mg/100 gm	11.25%
Protein	55 mg/day	0.88 gm/100 gm	1.65%
Carbohydrate	130 gm/day	30 gm/100 gm	23.07%
Fibre	40gm/2000 Kcal	8.90 gm/100 gm	22.35%

Table no. 7 DV% of Instant Sattu premix drink

DV% FOR INSTANT SATTU PREMIX DRINK			
Nutrients*	RDA 2020	Product Provides	DV%
Iron	32 mg/day	12.1 mg/100 gm	37.50%
Protein	55 mg/day	20/100 gm	40%
Carbohydrate	130 gm/day	56/100 gm	43.07%
Fibre	40gm/2000 Kcal	16.03gm/100 gm	40.07%

Nutrients*- RDA for iron and protein is considered from the highest adolescent requirement. Carbohydrate value is considered from recommended allowance, which is same for adults and adolescents. RDA for Fiber is 40gm/2000kcal.

IV. CONCLUSION

The present study aimed to identify the nutritive potential of Garden cress seeds, as it contains 100 mg iron per 100 gm beside iron it has good amount of calcium and Phosphorous, and is cost effective. Two low-cost recipes, Fruit leather and Instant Sattu premix drink with three variants each were developed. Sensory evaluation was conducted using hedonic rating scale, rating was done on five attributes- colour, taste, appearance, texture and overall acceptability. Iron and proximate analysis was conducted for most liked variants and the results were up to par. On statistical analysis, it was verified that all variants of the products are significantly different from each other on all five attributes. The production and packaging cost were comparatively lower than market price.

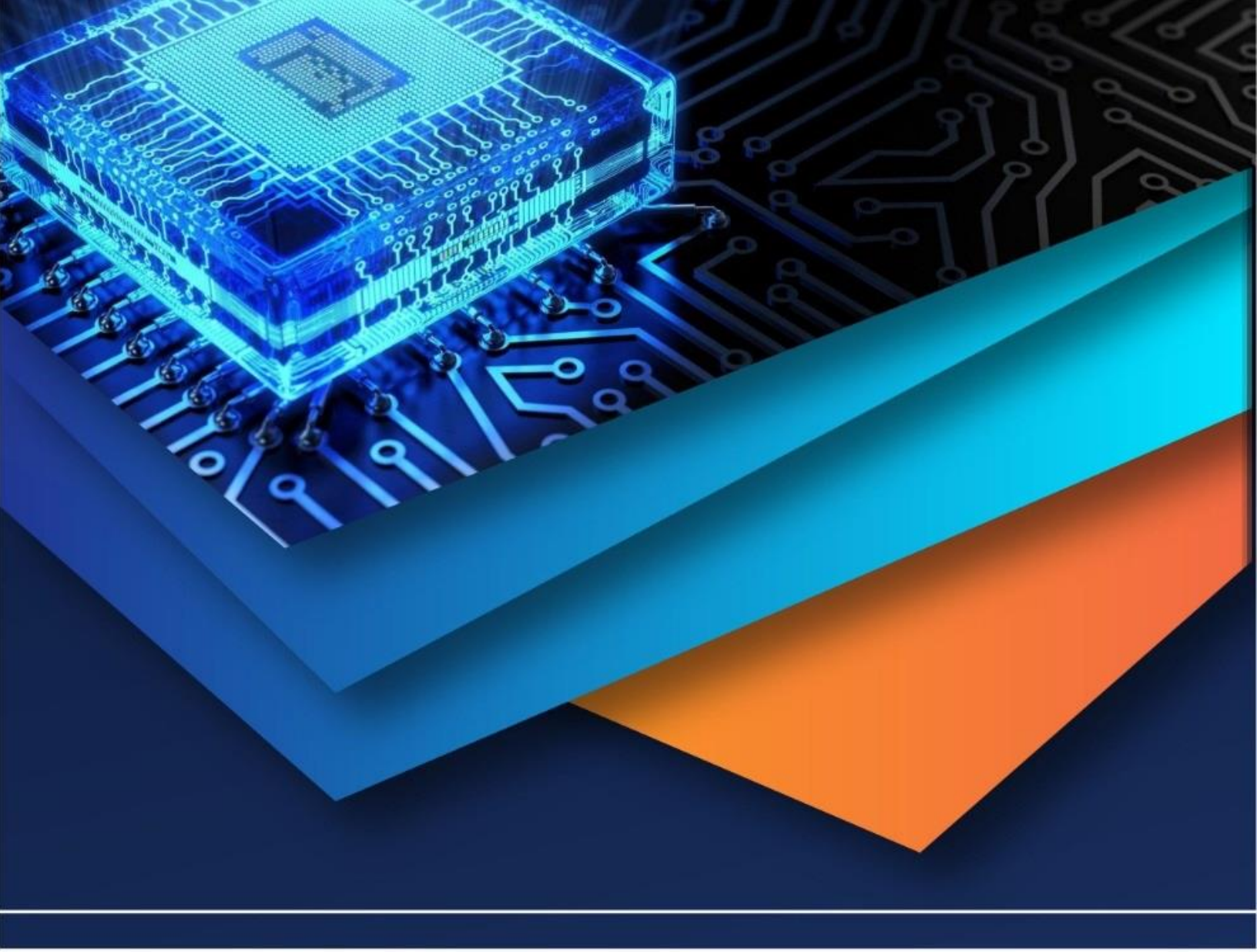
Hence the products developed are affordable by majority of public, particularly to lower income group and is rich in iron, it can we used as supplements to combat iron deficiency anaemia and as intervention tools to eliminate micro nutrient deficiency as it is pragmatic food model for food industries.

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