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Estimation Of Nutritional Composition AndSensory Evaluation Of Fero Nutri BarsDeveloped Using Euryale Ferox (Makhanaseeds).

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Brief Statement About The Significance Of Work And Key Findings.

Euryale ferox salisb are starchy white seeds which are edible locally known as makhana, is the main aquatic cash crop of Mithila (North Bihar), India. The commercial value of makhana seeds lies in their popped form. The starchy white puffs are very nutritious and tasty, and marketed as a premium dry fruit commodity of makhana. In spite of the unique properties Euryale ferox seeds, consumer awareness about the seeds and their nutritional benefits is very meager. Inclusion of these seeds in the diets is restricted to traditional and ceremonial preparations in the northern states of India. The benefits of this wonder seed are not disseminated effectively among the population hence promoting this seed needs an urgent attention. **Hence ,the aim of the study was** to develop fero Nutribar using ***Euryale ferox (Makhana Seeds)***

Key findings:

- Fero Nutribar is gluten free
- Fero Nutribar contributes to the rich source of calcium, iron, protein, fiber.
- Incorporation of Makhana along with oats has shown a significant enhancement in nutritional composition.
- Usually nutribars are aimed to develop with the rich sources of macronutrients. But Fero nutribar is a snack that is rich with micro-nutrients which are essential for the proper functioning of the body.

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`Estimation Of Nutritional Composition And Sensory Evaluation Of Fero Nutri Bars Developed Using Euryale Ferox (Makhana Seeds)

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Abstract

Euryale Ferox Salisb Also Known As Fox Nut Or Gorgon Nut Are Edible Starchy White Seeds Rich In Nutrients. In Spite Of Their Unique Properties, Consumer Awareness About These Seeds And Their Nutritional Benefits Is Very Meager. The Aim Of The Study Is To Develop A Fero Nutribar Using Euryale Ferox And Estimate Its Nutritional Composition And Sensory Attributes.Nutribars- Standard Using Oats, Variation I- Partial Replacement With Euryale Ferox 50% And Variation Ii- Complete Replacement With Euryale Ferox 100% Were Developed And Their Sensory Attributes Were Evaluated By - Point Hedonic Scale. Their Proximate Compositions Were Also Estimated. Mean Sensory Scores For Preference Given By The Panelist To The Sensory Attributes Shows That The Scores Ranged From Like Moderately To Like Very Much As Preferred By The Panelist For All The Nutribars. The Overall Acceptability For Variation-II Was Higher (Mean Score Of 8.2±1.20). Comparison Of Proximate Between Standard Nutribar And Fero Nutribar Variation-I Revealed Significantly Higher Concentration Of Total Fat(P=0.024),Crudefiber(P=0.032) And Calcium(P=0.014) In Fero Nutribar Variation-I. In Standard Nutribar Significantly High Levels Of Total Carbohydrates (P=0.26),Energy (P=0.01) And Iron(P=0.09)Were Noticed. Comparison Of Proximates Between Standard Nutribar And Fero Nutribar Variation-II Revealed Significantly Higher Concentration Of Crude Fiber (P=0.033) And Iron (P=0.005) In Feronutribar Variation Ii While Comparison Of Proximates Between Feronutribar Variation I And Ii Revealed A Significantly Higher Concentration Of Total Fat (P=0.01) And Calcium(P=0.005) In Fero Nutribar Variation-I,

Feronutribar (Variation-II) Contributed Higher Levels Of Iron(P=0.005).The Research Findings Suggest That Popped Makhana Seeds Hold A Promising Future As A Value -Added Alternate Gluten-Free Protein Supplement And Potential Source Of Iron, Calcium And Fibre.

Keywords: Makhana Seeds, Nutritious Bar, Euryale Ferox, Nutritional Benefits, Gluten Free Protein Source

1. Introduction:

Euryale Ferox Salsib Is An Aquatic Crop Belonging To Family Nymphaeaceae Which Has High Nutritional Values And Is Easily And Cheaply Cultivated In Suitable Standing Pools.[1].It Could Serve As An Alternative Source Of Food In Other Parts Of India And The World. Bihar, In India, Is The Leading State In Its Production And Processing. [2] The Makhana Seeds Are Traded And Exported, Raw Or Roasted.

Perisperm In The Seed Of E. Ferox Is Its Edible Part. Edible Seeds Are Converted Into Popped Form Through An Arduous Method Of Post-Harvest Processing. The Commercial Value Of Makhana Seeds Lies In Their Popped Form.[3] The Starchy White Puffs Are Nutritious And Tasty, And Marketed As A Best Dry Fruit Commodity. Seeds Of Makhana Are Also Reported For Its Medicinal Properties, And It Is Mostly Used In Ayurveda And Chinese Formulations For The Treatment Of A Variety Of Diseases, Such As Kidney Failure, Chronic Diarrhea, Extreme Leucorrhea And Hypofunction Of The Spleen.[4]It Strengthen The Heart And Is Very Helpful In Anemia.[5] However, It Is A Good Source Of Carbohydrate (Starch), Protein, Minerals And Many Other Nutritional Ingredients. Makhana Seeds Are A Wonderful Medicinal Plant Used In Ancient Medicine In India And China 3000 Years Ago. [6]

1.2 Processing Of Euryale Ferox Seeds

Currently, *Euryale Ferox* Are Popped By The Conventional Method. The Nuts Are Composed From The Water And Popped To Remove The Edible Starchy Kernel. Popping Is The Procedure Of Creating Superheated Vapour Surrounded By The Conditioned Nut By Heating The Contained Moisture And Suddenly Releasing The Pressure To Cause A Volume Expansion Of The Kernel. The Kernel Obtained Through This Procedure Is Called Popped Kernel And In India It Is Known Makhana. Euryale Ferox Seeds Are Utilized In The Preparation Of Curry And Puddings. Salted And Fried Makhana Is Served As A Snack With Tea And Coffee. It Is Also Used In Spiritual Rituals And Is A Good Source Of Starch For The Textile Industries[7]

Makhana Processors And Industrialists Are Also On The Lookout To Develop Some Value Added Products From Makhana. Makhana Therefore Requires Additional Processing To Get Some Value-Added Products Of Least Volume. To Extend Any Kind Of Product And Mechanical System For Their Production, Physical Properties Are Required. Furthermore, Since Makhana Is A Seasonal And Regional Crop Its Storage Conditions Are Also Needed For Keeping It Appropriately At Processing Centers. [8]The Conventional Processing Of

Makhana, I.E. Grading, Roasting And Popping Of Makhana Seeds Is Very Monotonous And Back Breaking Work.

The Makhana Seeds Are Graded, Cleaned And Dried Manually. Grading Is Done So That The Heating And Impact Force For Popping Remains Uniform. The Nuts Are Preheated, Tempered And Roasted In A Cast Iron Pan In Single Layer Over The Fire With Constant Stirring.[9]Within 2 Min, A Crackling Sound Is Heard From The Nuts Being Roasted. This Is An Indication Of The Optimal Roasting Of Nuts. The Roasted Nuts, 5 To 7 In Number, Are Scooped Quickly By Hand From The Pan And Kept On A Hard Surface And Rapid Contact Force Is Applied On Them By Means Of A Wooden Hammer. The Kernel Pops Out In Expanded Form, Which Is Known As Makhana. [10]

1.3 Nutritional Properties Of Euryale Ferox

Makhana Seed With Modest 10-12 Percent Protein Content Is Known For Its Elevated Essential Amino Acid Index (Eaai) Of About 90 Percent. It Has About 78 Percent Carbohydrate And 0.1% Fat Content And Is Rich In Minerals.[11]The Raw Seed Had A 362 Kcal/100gm Of Calorific Value Against 328kcal/100gm In Its Popped Form. Though, Its Biological Value Is Low (Around 55) Which May Be Attributed To The High Ratio Of Leucine To Isoleucine Amino Acids In Its Seeds. Good Quality Makhana Usually Called Rasgulla (Or Lava), Constitute Roughly 54 Percent Of Pops, Followed By 35 And 11 Percent, Correspondingly, The Medium Quality Murra And The Low-Grade Thurri Types. Euryale Ferox Seeds Are Rich Source Of Macronutrient Like Ca And Mg And Also Many Micro-Nutrients (Shankar, 2016).It Is Nutritious And Easily Digested.[12]

1.4 Products Developed Using Euryale Ferox:

Makhana Seeds Are Used As Snacks: Sweetened Form, Kheer, Halwa, Dal Makhni Kofta, And Dum Aloo, Fried Form (Mostly Used By Those Who Perform The Ritual Fasts, By Frying Pops In Ghee And Adding Rock Salt To The Same). Some Other Culinary Items Of Makhana Include Palak Makhana, Makhana Curry, Makhana Pulao, Nutty Makhana Curry, Matar Phool Makhana, Choco Makhana, And Makhana Chops Etc. Euryale Ferox Seeds Are Utilized In The Preparation Of Curry And Puddings. Salted And Fried Makhana Is Served As A Snack With Tea And Coffee. These Seeds Are Consumed In Raw Or Roasted Forms As Well As Flour Of Dried Seeds Was Used As Nutritious Bread.[13] In Spite Of The Unique Properties Euryale Ferox Seeds, Consumer Awareness About The Seeds And Their Nutritional Benefits Is Very Meager. Inclusion Of These Seeds In The Diets Is Restricted To Traditional And Ceremonial Preparations In The Northern States Of India.[14]

The Benefits Of This Wonder Seed Are Not Disseminated Effectively Among The Population Hence Promoting This Seed Needs Can Increase The Awareness. The Objectives Of Present Study Are -Development Of Fero Nutribar Using Euryale Fero(Makhana) As A Major Ingredient. To Evaluate And Compare The Sensory Properties And Nutritional Composition Of The Developed Product- (Standard Nutribar (Oats), Feronutribar -Variation-I(Partial Replacement) And Variation-Ii(Complete Replacement).

2. Materials and methods

The Study Was Planned In 3 Stages - Product Development, Sensory Evaluation And Proximate Analysis. Product Development Involved Purchase Of Popped Makhana Seeds And Raw Ingredients From The Local Super Market In Kolar. And Development Of Standard Nutribar (Oats), Fero-Nutribar Variation-I(Partial Replacement) And Fero Nutribar Variation-Ii(Complete Replacement) Was Carried Out. Sensory Evaluation Of The Developed Products Was Done By 15 Semi-Trained Panelists By Using Hedonic 9 Point Scale. The Proximate Analysis (Moisture, Ash, Protein, Fat, Carbohydrate, Crude Fiber, Iron, Calcium) Of The Developed Nutribar Was Analyzed Using Aoac Procedures.

Table:01 Ingredients And Method Of Preparation Of The Nutribar

2.1. Product Development

Purchase Of Raw Materials: The Raw Materials Required For Development Of Nutribar Were Procured From The Locally Available Stores In Kolar.

2.1.2 Development And Standardization Of Nutribar

Table-2 : Information On The Ingredients Used To Develop Nutribar(Standard Nutribar, Feronutribar Variation-I, Variation-Ii)

Ingredients	Standard	Variation-I	Variation-Ii
Roasted Oats	150gm	75gm	-
Makhana	-	75gm	150gm
Dried Fruit	50gm	50gm	50gm

Sl.No	Ingredients	Quantity	Method Of Preparation
1	Oats	50g	• In A Pan Add Some Oil And Salt • Add Oats. Roast Them On A Medium Heat Till They Become Crunchy And Acquire Some Color. Keep It On A Plate And Set Aside • Stir Everything Till You Get A Sand Like Mixture • Dump The Mixture Into The Baking Pan And Try To Spread Evenly With Help Of A Flat Bowl So That Everything Gets Sets Together. • Refrigerate For One Hour To Set Properly. Place It Upside Down On A Chopping Board And Cut Into Desired Bars With A Sharp Knife.
2	Pitted Dates	50g	
3	Almonds	25g	
4	Honey	35g	
5	Butter	50g	
6	Jaggery	50g	

Mixed Nuts	25gm	25gm	25gm
Butter	60gm	60gm	60gm

2.3 Sensory Evaluation

Sensory Evaluation Of 9-Point Hedonic Scale Was Carried Out By 15 Semi-Trained Panel Members. Scores Of 9 Point Scale The Scoring System Of 9 Point Hedonic Scale Ranges From 1-9. 9- Like Extremely; 8-Like Very Much; 7-Like Moderately; 6- Like Slightly; 5-Neither Like Nor Dislike; 4-Dislike Slightly; 3-Dislike Moderately; 2-Dislike Very Much; 1-Dislike Extremely.

3. Proximate Analysis

Proximate Analysis Of The Standard Nutribar, Fero Nutribar Variation-I And Fero Nutribar Variation-Ii Were Analyzed By Using Standard Aoac Procedures. And The Proximate That Were Analyzed Are Moisture, Ash, Fat, Carbohydrate, Crude Fiber, Iron, Calcium.

4. Statistical Analysis

Data Is Presented As Mean ± Standard Deviation.2 Sample Student T- Test Was Used To Determine Significant Difference Between Standard Nutribar And Fero Nutribar Variation-I And Variation-Ii. Xlstat2021 Software Was Used To Perform.

5.Results And Disscusion

Tableno-3: Mean Sensory Attributes Of Nutribar (Standard,V-I Partial Replacement With Makhana,Vii – Complete Replacement With Makhana) Obtained Using Hedonic 9 Points Scale

Samples	Color	Texture	Taste	Aroma	Overall Acceptability
			Mean±Sd		
Standard	8±1.06	7.5±1.18	7.9±0.88	7.5±1.24	8±0.75
Variation-I	7.7±0.96	7.1±1.55	7.53±1.18	7.4±1.29	7.66±0.89
Variation-Ii	8.06±1.03	7.93±1.48	8.13±1.24	7.66±1.39	8.2±1.20

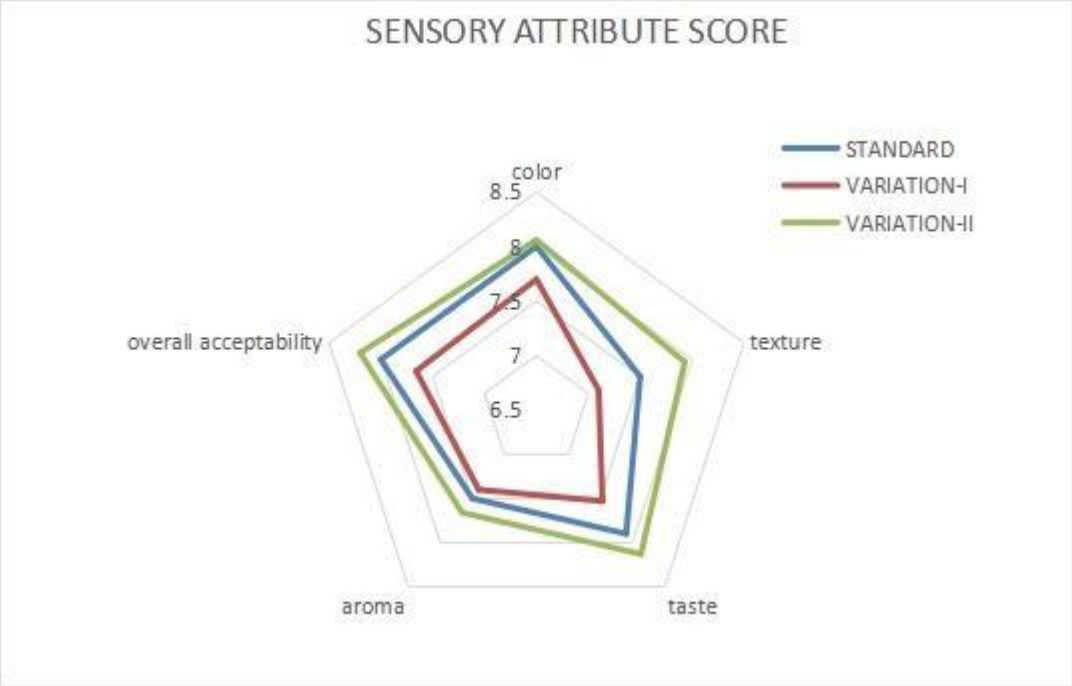

Fig No-1: Mean Sensory Attributes Of Nutribar (Standard,V1-Partial Replacement With Makhana,V2-Complete Replacement With Makhana) Obtained Using Hedonic 9 Points Scale Projected As Radar Chart.

Table No-3 Projects The Mean Scores For The Preference Given By The Panelist To The Sensory Attributes Such As Color, Texture, Aroma, Flavor Using 9 Point Hedonic Scale The Sensory Scores For All The Sensory Attributes Ranged From Like Moderately To Like Very Much As Preferred By The Panelist For Feronutribar Standard, Variation-I, Variation-Ii. Standard And Variation Ii Had A Mean Score Of Approximately 8±0.75 And 8.2±1.20 Respectively Indicating A High Overall Acceptability However, It Can Be Noticed From The Table And The Radar Chart Figure No-1 That Variation-I Had Low Acceptability When Compared To Standard And Variation-Ii.

Proximate Analysis Of The Developed Nutribar (Standard,Variation-I,Variation-Ii)

Table No-4: Proximates Per 100 Grams

Proximates	Standard(Oats)	Variation-I	Variation-II
Energy	387.0kcal	381.0kcal	380.5kcal
Total Fat	2.2g	2.9g	2.3g
Total Carbohydrates	85.6g	82.3g	83.4g
Protein	6.2g	6.5g	6.5g
Crude Fiber	1.0g	1.3g	1.4g
Calcium	88.0mg	96.0mg	80.0mg
Iron	8.3mg	8.0mg	9.5mg
Moisture	6.32mg	6.56mg	6.1mg

Proximate Composition Of The Standard Nutri Bar Was Compared With Feronutribar Variation-Iand Variation-Ii,The Data From The Table No-4 Reveals That Standard Nutri Bar Contributed More Energy (387kcal) Then Feronutribar Variation-I And Variation-Ii. The Energy Component Of Feronutribar Variation-I And Variation-Ii Were Essentially Similar. Total Fat In Feronutribar Variation-I Was Comparatively Higher Than Standard Nutribar And Feronutribar Variation-Ii. Total Carbohydrates Was Essentially Similar. However, Standard Nutribar Had Higher Value (85.6g).Protein, Crude Fiber And Moisture Contributed By The Standard Nutribar, Feronutribar Variation-I And Variation-Ii Were Essentially Similar. Higher Amount Of Calcium Was Present In Variation-I (95mg) While Fero Nutribar Variation-Ii Had Higher Iron Levels (9.5mg).

Table No-5: Comparisons Of Proximate (Standard Nutribar, Fero Nutribar Variation I, Variation Ii)

Proximates	Std Mean±Sd	V1 Mean±Sd	T P Df	Std Mean±Sd	V2 Mean±Sd	T P Df	V1 Mean±Sd	V2 Mean±Sd	T P Df
Moisture	6.40±0.12	6.30±0.21	0.25 0.822	6.40±0.12	6.36±0.08	0.3 0.72	6.35±0.21	6.36±0.80	-0.03 0.972
Total Fat	2.27±0.10	2.85±0.07	-6.37 0.0242	2.27±0.10	2.35±0.07	-0.83 0.492	2.85±0.07	2.35±0.07	7.07 0.012
Total Carbohydrates	85.6±0.63	82.3±0.77	6.05 0.262	85.6±1.83	83.4±1.90	-0.24 0.832	82.3±0.07	83.4±0.63	-3.60 0.072
Energy	387±0.7	381±0.7	7.07 0.012	387±0.70	380.5±0.70	11.31 0.0082	381±0.70	380.5±0.70	1.002
Proteins	6.2±0.07	6.5±0.07	-2.82 0.102	6.2±0.07	6.5±0.07	-2.82 0.102	6.5±0.14	6.5±0.07	-1.34 0.312

Crude Fibre	0.95±0.07	1.35±0.07	-5.67 0.03 2	0.950±0.07	1.35±0.07	-5.6 0.03 2	1.350±0.07	1.350±0.07	0 1 2
Calcium	87±1.41	96±0.70	-8.4 0.014 2	87.0±1.4	81±1.4	4.2 0.05 2	96.5±0.70	81±1.41	13.8 0.005 2
Iron	8.35±0.07	8.07±0.16	3.05 0.09 2	8.35±0.07	9.57±0.16	-13.5 0.005 2	8.07±0.10	9.57±0.10	-14.1 0.005 2

Comparison Of Proximate Between Standard Nutribar And Feronutribar Variation-I Revealed A Significant Difference In The Totalfat(P=0.024),Total Carbohydrates(P=0.22),Crudefiber(P=0.032) And Calcium(P=0.014). Feronutribar Variation-I Contributed Higher Total Fat(2.85g) ,Crude Fiber(1.35g) And Calcium(96mg/100g) And Standard Nutribar Contributed Higher Iron(8.3mg/100g).Comparison Of Proximate Between Standard Nutribar And Feronutribar Variation-Ii Reavealed Significant Difference In Energy(P=0.008) ,Crudefiber(P=0.033) , Calcium(P=0.05), Iron(P=0.005).Standard Nutribar Contributed Higher Energy (387 Kcal) And Calcium(87.0mg/100g) Than Compared Variation-Ii Fero Nutribar. Fero Nutribar Variation-Ii Contributed Higher Crude Fiber(1.35 Mg/100g) And Iron(9.57mg/100g).Comparison Of Proximate Between Feronutribar Variation-I And Variation-Ii. Reveal A Significant Difference In Total Fat (P=0.01), Total Carbohydrates (P=0.07), Calcium (P=0.005) And Iron (P=0.005).Fero-Nutribar (Variation-I) Contributed Significantly High Fat(2.85g) And Calcium(96.5mg/100g). Fero-Nutribar(Variation-Ii)Contributed Significantly Higher Carbohydrates(83.4g), And Iron(9.57mg/100g).

6.Conflict of interest: The authors declare that there is no conflict of interest.

7. Summary And Conclusion:

Standard Nutribar Was Prepared By Oats, Variation-I Was Prepared By 50% Replacement Of Oats And Variation-II Was Prepared By Complete Replacement Of Oats With Makhana. The Proximate Of Standard And Variation-I Revealed Significant Difference Of Calcium, Iron And Crude Fiber. Comparison Of Proximate Between Standard And Variation-II Contributed Significant Increase In Crude Fiber, Iron And Protein. The Proximate Comparison Of Variation-I And Variation-II Revealed That There Was Significant Difference In Iron And Fat. In Conclusion, Incorporating The Popped Seeds Or Flour In The Traditional Recipes Will Be Of Immense Value To Develop Low-Cost, Gluten-Free, Protein-Rich Food Supplements To Combat Malnutrition. Makhana Seeds Hold A Promising Future As A Value Added Alternate Gluten-Free Protein Supplement And Potential Nutraceutical And Pharmaceutical Source.

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