Section A-Research paper
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FORMULATION AND EVALUATION OF BROCCOLI, SPINACH AND MORINGA (DRUM STICK) POWDER AS A NUTRACEUTICALS.

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1.ABSTRACT:

The Aim is to formulate and evaluate the vegetables powders (broccoli, spinach, drumstick pod). Which has Excellent Nutritional properties. These all vegetables is enriched with excellent minerals contains such as calcium, potassium, Phosphorus, Iron, Magnesium, Zinc. It's also enriched with carbohydrate, Protein, vitamins (A,B,C,K), fatty acids, fibers and essential amino acids. the dehydration is an important unit operation to make vegetables in dried powder form; which increases the preservation capacity, longer shelf life, and reduces the transportation and storage cost. The powders were mixed; passed by sieve meshes. And evaluated by estimation of various physico chemical determination such as Protein, carbohydrate, fats, Mineral ash content, L-ascorbic acid (vitamin c) content; powder characteristics were measured by Bulk density, Tap density, Hauser's ratio, Carr's index, optical measurement by color value (L,a,b).

KEYWORDS: Formulate, Evaluate, Nutritional, Vegetables, Physico-chemical, powder characteristics.

INTRODUCTION:

BROCCOLI (BRASSICA OLERACEA):

Broccoli is an edible plant which is classified under the italic cultivar group of species Brassica oleracea. It is a type of cruciferous vegetable and belongs to family Brassicaceae. It was originated in Italy about 2000 years ago. The word broccoli comes from the Italian plural of broccolo, which means "the flowering crest of a cabbage" and is the diminutive form of brocco, meaning "small nail" or "sprout". Broccoli has large green flower head which is arranged like a tree like structure branching out from a thick edible stalk. Broccoli resembles

a cauliflower and has been considered a uniquely valuable food among Italians. Its common name include: Chou broccoli, common broccoli, calabrese, cruciferous vegetable, There are three types of broccoli. The most familiar is Calabrese broccoli, often referred as "broccoli". It has thick stalks and green heads. Sprouting broccoli consists of large number of heads with many stalks. Purple cauliflower has head shape with tiny flowering buds. Broccoli is a cool-weather crop which grows best at an average daily temperature between 18°and 23°.

Broccoli has high vitamin C and dietary fiber. It contains multiple nutrients like diindolylmethane (DIM) and small amount of selenium which has anticancer properties. Broccoli contains glucoraphanin which can be processed into anticancer compound sulforaphane. Sulforaphane (SFN) (4-methylsulfinylbutyl isothiocyanate) is a naturally occurring isothiocyanate, which was first identified in broccoli extracts. It was identified as the principal inducer of quinone reductase and glutathione S-transferases activity. It was noted in many studies that, sulforaphane can reduce the incidence of a number of **forms of tumor** Sulforaphane is a promising cancer chemo protective agent and hence has attracted many researchers' interest. As broccoli can be consumed both as fresh and processed food, it is regarded as a dual use vegetable. Typically, broccoli is processed as dried or frozen for retail sale, or canned for instant soup. By the booming number of health-conscious consumers, who prefer salad, side dish or a nutritious dietary supplement, broccoli offers great advantage and hence enhances its share of the market.

REPORTED PHARMACOLOGICAL ACTIVITY OF BROCCOLI:

1.AN IMMUNE SYSTEM BOOSTER:

2.HELPS TO REDUCE BLOOD PRESSURE:

3.SUPPORT STOMACH HEALTH:

4.HELP FOR SUN DAMAGED SKIN

5.BUILDING STRONG BONES:

6.REDUCED THE RISK OF HEART DISEASE:

7.A BIRTH DEFECT FIGHTER

8.CATARACT PREVENTIONS

9.DETOXIFICATION/CLEANSING ABILITY OF CELLS:-

10.PROTECTION AGAINST CANCER

A:-CRUCIFRES CUT RISK OF BLADDER CANCER:

B:- PROTECTIVE AGAINST OVARIAN CANCER:

11.PROSTATE CANCER:

TABLE 1: PROXIMATE NUTRITIONAL VALUE (/100gm) OF BROCCOLI

PRINCIPLE	NUTRIENT VALUE	%age of RDA
Energy	34 kcal	1.5
Carbohydrate	6.64g	5
Protein	2.82g	5
Total Fat	0.37g	1
Cholesterol	0mg	0
Dietary Fiber	2.60g	7

TABLE 2: PROXIMATE VITAMINS (/100gm) IN BROCCOLI

MINERALS	NUTRIENT VALUE	%age of RDA
Calcium	47mg	5
Copper	0.049mg	5.5
Iron	0.73mg	9
Magnesium	21mg	5
Manganese	0.210mg	9
Selenium	2.5mcg	5
Zinc	0.41mg	4

TABLE 3: PROXIMATE MINERALS (/100 gm) IN BROCCOLI

VITAMINS	NUTRIENT VALUE	%age of RDA
Folates	63mcg	16
Niacin	0.639mg	4
Pantothenic acid	0.573mg	12

Pyridoxine	0.175mg	13
Riboflavin	0.117mg	9
Thiamine	0.071mg	6
Vitamin A	623IU	21
Vitamin C	89.2mg	149
Vitamin K	0.17mg	1.5
Vitamin E	101.6mcg	85

TABLE 4: ELECTROLYTES AND PHYTONUTRIENTS IN BROCCOLI

ELECTROLYTES	NUTRIENT VALUE	%Age of RDA
Sodium	33mg	2
Potassium	316mcg	7
PHYTO-NUTRIENTS	**NUTRIENT VALUE**	**%Age of RDA**
β-carotene	361mcg	--
β-crypto-xanthan	1mcg	--
Lutein-zeaxanthan	1403mcg	--

SPINACH (SPINACIA OLERACEA):

Spinach (Spinacia oleracea) is a plant belongs to Amaranthaceae or Chenopodiceae family and considered to be the native to central and south western Asia. It is cultivated throughout the world as cool season annual leafy vegetable. It is preferably utilized in food as raw, boiled, canned, frozen, dehydrated, pureed form and cooked or baked into various dishes. Chlorophyll is the important constituent of leaf responsible for photosynthesis and green coloration. The color of the leaves changes from green to olive green or brown on thermal processing mainly due to conversion of chlorophyll to pheophytin and pyropheophytin applying the non-enzymatic pathway. Formation of chlorophyllin and arresting further conversion is a major challenge and could be achieved through the controlled processing for obtaining the highly acceptable dehydrated leaf powder enriched with carotenoids, vitamin C and vitamin E content.

It is an annual plant (rarely biennial), growing as tall as 30 cm (1 ft). Spinach may overwinter in temperate regions. The leaves are alternate, simple, ovate to triangular, and very variable in size: 2–30 cm (1–12 in) long and 1–15 cm (0.4–5.9 in) broad, with larger leaves at the base of the plant and small leaves higher on the flowering stem. The flowers are inconspicuous, yellow-green, 3–4 mm (0.1–0.2 in) in diameter, and mature into a small, hard, dry, lumpy fruit cluster 5–10 mm (0.2–0.4 in) across containing several seeds.

Spinach contains high amount of moisture, which reduces rapidly due to transpiration resulting in the loss of cell turgor. Being enormous exposed surface area in respect to the

occupied volume, the transpirational loss are more and resulted in the rapid quality deterioration thus spinach leaf is categorized under highly perishable category.

However, major problems associated with the powders containing fine particles are the inherent difficulties in reconstitution, problems of dusting or lumping and improper flow properties during handling. But addition of small quantities of leaf powder not only improves the taste and color of food stuffs but also enhance the nutritional values. Considering the mentioned importance, the present study was conducted specifically in order to characterize the functional leaf powder of spinach so as to use as ready to use material in various food formulations.

HEALTH BENEFITS OF SPINACH ON DISEASES / DISORDERS:-

1.ANEAMIA:

2.NIGHT BLINDNESS:

3.ACIDOSIS:

4.LIVER TONIC:

5.RESPIRATORY DISORERS:

6.HEART HEALTH:

7. CANCER:

8.DIABETES:

9. TOOTH DISORDERS:

10.PREGNANCY AND LACTATION:

11. URINARY DISORDERS:

12.BONES:

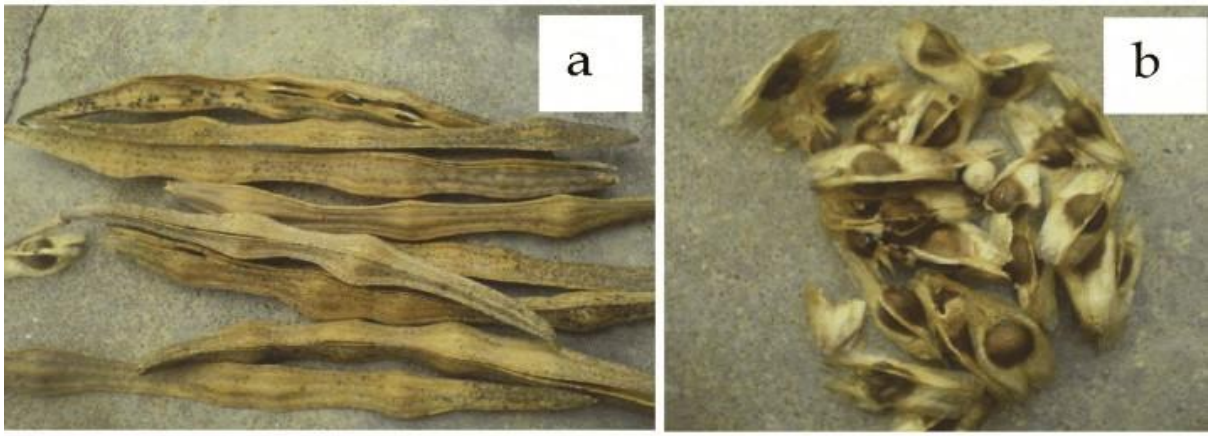
- **Food Value of spinach * Values per 100 gms edible portion**

Moisture	**92.1%**
Protein	**2.0%**
Fat	**0.7%**
Minerals	**1.7%**
Fibre	**0.6%**
Carbohydrates	**2.9%**

(MORINGA OLEIFERA LAM.) DRUM STICK/PODS:

Moringa oleifera Lam. (Synonymous: Moringa pterygosperma Gaertn), a medium-sized tree, is commercially cultivated mainly for its pods, leaves and seeds. The tree is often referred to as a "wondertree" due to its multi uses and is also known as "Drumstick-tree and Horseradish tree. In Africa, the tree is known as mother's best friend. Drumstick tree is also referred as an exceptionally precious vegetable tree which is referred as "Miracle Tree" or "Wonder Tree", "Natural Nutrition for Tropics" (Fugile 2001) and "Mother's Best Friend" (Sudhir et al 2010). due to its several nutritional, pharmacological and industrial applications. Thus, drumstick leaves are found suitable to provide a biologically metabolized nutritional composition for health, well being and treatment of ailments. the modern taste for food and nutritional requirement of increasingly demanding against at the present junk food at the same time,due to accelerated pace of modern life,traditional vegetables are used to supplement the staple food but some are grown to please the taste and enhance the flavor,obviously drum stick is one of them which is commonly known as horsedish.

It is widely cultivated for its young seed pods and leaves, used as vegetables and for traditional herbal medicine. It is also used for water purification. Although listed as an invasive species in several countries, M. oleifera has "not been observed invading intact habitats or displacing native flora", so "should be regarded at present as a widely cultivated species with low invasive potential



(a) Dried pods (drumstick pod) (b) drumsick seeds (dried)

REPORTED PHARMACOLOGICAL ACTIVITY OF DRUMSTICK POD

ANTHELMINTIC ACTIVITY:

Ethanolic extract of moringa oleifera seeds shows more anthelmintic activity against indian earth worm pheritima posthuma, compare to vitex negundo.time for and paralysis and time for death of worms with moringa oleifera leaves were less compare to root of vitex negundo

ANTIULCER ACTIVITY:

Aqueous extract of moringa oleifera leaves exhibit anti ulcer activity in various animal models on adult holtzman albino rats of either sex.

ANTICANCER ACTIVITY:

Various extract of leaves and ethanolic extract of seeds of moringa oleifera shows anti tumor activity in in-vitro test .thiocarbamate and isothiocyanate relate compouns were isolated which act as inhibitor of tumor promotor teleocidin B-4 induced Epstein Barr virus(EBV) activation in raji cells.

ANTIDIABETIC ACTIVITY:

Aqueous extract of moringa leaves shows anti diabetic activity on glucose tolerance in Goto-Kakizaki and wistar rats.

ANTI-INFLAMMATORY ACTIVITY:

Methanolic extract of root bark, aqueous extract of roots, methanolic extract of leaves and flowers as well as ethanolic extract of seed of moringa oleifera shows anti-inflammatory activity in carrageenin induced pawedema model.

HEPATOPROTECTIVE ACTIVITY:

Ethanolic extract of leaves and alcoholic extract of seeds of moringa oleifera shown hepetoprotective effect in isoniazid, rifampicin, pyrazinamide induced liver damage diclofenac induced hepatic toxicity in rat, respectively.

ANTIMICROBIAL ACTIVITY:

Seeds of moringa oleifera shows in in-vitro antimicrobial activity against bacteria(Bacillus cereus,candida albicans,staphaylococcus epidermidis,Basillus subtilus,shigella shinga,shigella sonnei,Pseudomonas aeruginosa,E.colli and aspergillus niger.) yeast,dermatophytes and helminthes in a disk diffusion techniqes,it was also reported that moringa oleifera exhibit anti-fungal activity in both broth ilution and agar plate method against trichophyton rubrum,and T.mentagraphytes,trichophyton mentagrophytes,epidermophyton xoccosum, and microsporum canis,Fusarium solani and Rhizopus solani.benzyl isothiocyanate,benzyl glucosinolate and pterygospermin are the responsible chemical constituents for its antibiotic activity.

Protein		2.5g
Carotene		110mcg
Fat		0.1g
Minerals		2.0g
Fiber		4.8g
Carbohydrates		3.7g
Calories		26
Calcium		30mg
Phosphorus		110mg
Iron		0.18mg

Nutritional properties of Drumstick pods

*All values are per 100 grams of edible portion

Magnesium	28
Sodium	0
Potassium	259
Copper	0.01
Manganese	0.05
Zinc	0.16
Chromium	0.003
Chlorine	423
Thiamine	0.05
Riboflavin	0.07
Niacin	0.2
Vitamin C	120

METHODS AND PREPARATION:

SAMPLE PREPARATION:

Broccoli florets:

Fresh broccoli heads were used per experimental replication. The average weight of a broccoli head was 4-6 g. Broccoli was cleaned and separated into florets with stems to produce samples. The following blanching processing is 101°C for 2 min parameters were applied. Blanching samples for microwave drying analyses were cooled to room temperature (25 ± 2°C).

Spinach leaves:

Fresh and undamaged leaves were separated, washed to remove foreign matter such as dust, dirt, chaff and immature leaves using tap water. The recovery of usable portions of spinach leaf was found in order of 45.753±2.616% from the harvested portions. The moisture content of fresh spinach leaves was found to be 91.81±0.01% (wwb).

Moringa (drumstick) pods/fruits:

Wash the pods/fruit with clean water.wipping it with clean cotton and send it for drying

DRYING PROCESS:

- **Drying of Broccoli**:
  The cabinet dryer was used for drying with the capacity of twelve trays. The broccoli was spread evenly in a single layer on trays. The trays were placed inside the cabinet dryer maintained at 50 ºC and dried till they attained similar amount of moisture content. Freeze drying process took 72 hours to dry the broccoli. Freeze drying is a process whereby water or other solvent is removed from frozen material by converting the frozen water directly into vapor without the intermediate formation of liquid water. The fan drying method was used for drying of broccoli. The broccoli was spread evenly in a single layer on trays. The trays were placed in open room under fan for 1 month. The sun drying method was used for drying of broccoli. The broccoli was spread evenly in a single layer on trays. The trays were kept under open sun light for 6 hours for 9 days. The solar drying method was used for drying of broccoli. The broccoli was spread evenly in a single layer on trays of solar drier. The solar drier was kept in sunlight facing direct rays of sun for 6 hrs for 3 days.
- **Drying of spinach:**
  Drying behaviour of spinach leaves were investigated at four different isothermal temperatures (50, 60, 70 and 80 0C) in a developed cabinet dryer (Ankita and Prasad, 2013). The dehydration process was carried out for at least three hours durations. The obtained dried samples at different temperatures were subjected for manual crushing initially and further using mixer grinder to get spinach powder for further studies. A

set of screens (10-12-16-25-60-85 BSS) was used to classify the powder fractions based on size.

- **Drying of moringa pods:**
  Wash the pods/fruit with clean water.wipping it with clean cotton and keep it in well ventilated shed house to avoid direct sun light on it and where air easily around it.after some days according to drying condition its crushed mechanically and grind it and pass the powder through mesh sieve size (0.027 inches)

NUTRACEUTICALS and evolution of powder: -

(1). ESTIMATION OF PROTEIN (MODIFIED BIURATE TEST):

Reagent: -

(a) standard :- 0.5% g\100ml protein standard solution

(b) Ethanol :- Ether (2 : 1v\v)

(c) 10% TCA

(d) Biuret reagent

Procedure: -

I – Preparation of test sample: -

1. Take 1 g of sample and extract it with ethanol (2:1) and make up the volume to 5 ml.
2. Centrifuge for 10 minutes. Shake and decant.
3. Supernanent containing liquid was removed and the sediment left was fat free samples.
4. This sediment was taken and it was shaken with 10 ml of cold 10% TCA.
5. Protein gets precipitated and again centrifugation was done.
6. Residue was taken and 2 ml of ethyl ether was added to it.
7. This was suspended in 4 ml of distilled water and shaken well with glass rod.
8. Estimate test by taking 1 ml of this test solution, adding 6 ml of biuret reagent and 4 ml of distilled water.

II – Preparation of standard: -

To 1 ml of standard protein solution, add 6 ml of biuret reagent and 4 ml of distilled water.

III – Preparation of blank: -

Take 5 ml of distilled water and add 6 ml of biuret reagent.

Extinction was read at 540 nm in a spectrophotometer.

Calculation: -

Total protein concentration (g \100 ml) =

$$\%\text{Nitrogen} = \frac{TS - TB \times \text{Normality of acid} \times 0.014}{\text{Weight of sample}}$$

(2). ESTIMATION OF MOISTURE CONTENT: *(Sharma, 2007)*

Procedure:-

1. Weigh 8- 10 g well mixed sample in an already weighed, dry – tasted high and dry in a oven at 100^{o} C for 2-3 hours.
2. Cooling in a desiccators and weigh accurately.
3. Respectively drying, cooling and weighing until the weigh becomes constant.

Calculation:-

$$\text{Moisture content of sample (g\100g)} = \frac{\text{initial wt.(g)} - \text{final wt.(g)}}{\text{Weight of sample (g)}} \times 100$$

(3). ESTIMATION OF MINERAL ASH CONTENT: *(Sharma, 2007)*

Procedure:-

1. Weigh accurately 6-10 g of sample in a previously ignited, cooled and weighed platinum crucible.
2. Heat the crucible gently by placing it on a clay triangle over a burner until the mass is well charged.
3. Ignite in a muffle furnace of 600^{0}C for 4-5 hours.
4. A light grey ash marks the completion of ashing process.
5. Cool in a dessicators and weigh.
6. Repeat heating, cooling and weighing until weigh of the ash is constant.

(4). ESTIMATION OF FAT CONTENT: *(Sharma, 2007)*

Generally the fat content is estimated in a dry sample following the removal of moisture.

Reagent :- (a) Solvent ether or petroleum ether

Apparatus: - Soxhlet apparatus

Procedure:-

In procedure involved a 15 hours extraction from accurately weighed dry sample (8-10 g) in soxhlet apparatus. Solvent ether of the fat extract obtained is evaporated to dryness and residue further dried in the oven at 70-80^{0}C cooled in a dessicators and finally weighed accurately. The fat content is expressed in g\100g of fresh sample to wet weigh is made from the extent of decrease in weigh of the given sample on its completely drying out.

(5). ESTIMATION OF CARBOHYDRATE: *(Sharma, 2007)*

Substract from 100, a sum of values (g\100g) for moisture, protein, fat, ash and crude fiber to get the carbohydrate content (g\100g) of sample.

Carbohydrate (g\100g) = 100 – (moisture + fat + protein + ash + fiber)

(6). ESTIMATION OF L-ASCORBIC ACID:*(AOAC, 1980)*

Principle: - Vitamin-C (L-ascorbic acid) gets oxidized to its dehydro form by air, especially at alkaline ph. However it remains stable in acid solution, it is therefore necessary to stabilize vitamin C by extracting it in metaphosphoric acid or in a mixture of metaphosphoric acid dilute acetic acid before its estimation. The estimation was carried out by titration of vitamin C with 2,6-dichlorophenol indophenol solution.

Oxidized form of the dye has a blue color in alkaline medium and red in acidic medium. Reduced form, on the other hand has no color and its termed as leuco form. The redox reaction occurring during the titration, proceeds as under.

Reagent:-

(a) Dye (2,6 DCPIP) dissolve 52 mg of sodium salt of the dye and 42 mg of sodium bicarbonate in water make up of the final volume of 500 ml.
(b) Standard vitamin C solution: Dissolve 10 mg of vitamin C in 6% metaphosphoric acid and make up the final volume in 1 litre with metaphosphoric acid.
(c) Metaphpsphoric acid: Dissolve 60 gm metaphosphoric acid in 1 litre distilled water.

Method:-

1. 10 gm a sample was ground in 40 ml of metaphosphoric acid to stabilize vitamin C content of the sample.
2. The content was centrifuged at 1000 rpm for 15 minute.
3. The supernatant was taken in 100 ml volumetric flask and volume made 100 ml by using 60 ml metaphosphoric acid.
4. 20 ml of sample was taken and titrated with dye solution.

Titration:-

1. The burette was filled with the dye solution.

2. 20 ml of standard vitamin C solution was taken in a conical flask and titrated against 2, 6 Dichlorophenol indophenol solution.
3. Faint pink color resisting for at least 15 seconds marked the completion of titration.

POWDER CHARACTERISTICS:

(1). ANGLE OF REPOSE:

$$\theta = \tan^{-1}\frac{h}{r}$$

- Where, h = height of the pile
- r = radius of base of pile
- Θ= angle of repose

(2). HAUSNER'S RATIO:

It is used to measure both bulk volume and tapped volume of powder.

$$Hausner\ Ratio = \frac{V_o}{V_f}$$

- Where, V0= unsettled apparent volume and Vf= final tapped volume
- It can also be measured in terms of density.

$$Hausner\ \ Ratio = \left(\frac{\rho_{tapped}}{\rho_{bulk}}\right)$$

Where,

- ρ tapped= bulk density
- ρ bulk= tapped density

(3). CARR'S INDEX:

$$Compressibility\ Index = 100 \times \left(\frac{V_0 - V_f}{V_0}\right)$$

Where,

V0= unsettled apparent volume

Vf= final tapped volume

it can also be measured in terms of density

$$Compressibility\ Index = 100 \times \left(\frac{\rho_{tapped} - \rho_{bulk}}{\rho_{tapped}} \right)$$

Where,

ρ *tapped*= bulk density ρ bulk= tapped density

(4). WATER ABSORPTION INDEX (WAI):

WAI (g/g)= Weight gain of powder

Dry weight of sample

(5). WATER SOLUBILITY INDEX (WSI):

WSI(%) = Weight of dry solid in supernant

Dry weight of solid

(6). OPTICAL MEASUREMENT BY COLOR OBSERVATION:

The L*a*b* colour system is one of the uniform colour spaces recommended by CIE in 1976 as a way of more closely representing perceived colour and colour difference. In this system, L* is the lightness factor; a* and b* are the chromaticity co-ordinates.

• L* (lightness) axis – 0 is black; 100 is white.

• a* (red-green) axis – positive values are red; negative values are green; 0 is neutral.

• b* (yellow-blue) axis – positive values are yellow; negative values are blue; 0 is neutral

PREPARATION AND FORMULATION: (250gm)

- Take a 83.33gm broccoli powder and pass it by 25 seive mesh.
- Take a 83.33gm spinach dried powder and pass it through 25 sieve mesh.
- Take a 83.33gm drumstick pod powder and pass it through 25 sieve mesh.
- Mix all the powder uniformly upto 10-15 mins.
- Packed into a plastic bottle (250gm)

- **Direction and use: for smoothie preparation**

- Take 1 cup of powder + 1 peeled banana + 1 cup frozen pineapple + milk or water upto 150m

RESULT AND DISCUSSION:

TABLE 1: POWDER CHARACTERISTICS OF FORMULATION:

WAI = water absorption index, WSI = water solubility index

TABLE 2: CHEMICAL(NUTRITIONAL) ESTIMATION OF FOMULATION (250gm)

Parameters	**Result**
Moisture	11.32%
Carbohydrate	39.61%
Protein	24.33%
Fat	3.59%
Fibers	120.5 gm
Ash	12.19%
Chlorophyll	588.61 mg

TABLE 3 : MINERAL ESTIMATION OF FORMULATION (250gm)

Minerals	**Result**
Calcium	375 mg
Magnesium	122.5 mg
Potassium	940 mg
Zinc	1.42 mg
Iron	549.32 mg
Phosphorus	327.5 mg

TABLE 4:OPTICAL CHARACTERICTICS FOR COLOUR MEASUREMENT:

Parameters	**Result**
Bulk Density(gm/cm^3)	1.12
Tap Density(gm/cm^3)	1.59
Angle of Repose (^{o})	23.49
Carr's inex(%)	27.43
Hausner's Ratio	3.22
WAC g/g	2.03
WSI %	27.26

Parameters	**Result**
L – value	45.5
a – value	-2.73
b - value	19.26

The vegetable samples is prepared according to their drying techniques such as cabinate drying and freeze drying to make dried powder,then powder is further evaluated by various physico-chemical parameters such as Moisture content, Ash value, estimation of protein, carbohydrate, fat and further evaluated for powder flow properties such as Bulk density, tap density, Angle of Repose ,Carr's index, Hausner Ratio etc.The angle of repose indicates excellent flow property. Carr's index shows poor flow property. Hausner's ratio indicates very poor flow scale.

- The formulation is enriched with nutritional substance such as carbohydrate, protein, fats, fibers and minerals such as calcium, Iron, Phosphorus, Potassium, Magnesium, Manganese, zinc. Vitamines (A,B,C,K), Essential amino acids etc. as shown in table 2 and 3
- The color value L shows 45.5 which is between black and white index. a value shows negative value shows greenness. b value shows positive value 19.26 which shows yellowish color.

CONCLUSION:

In order to extend the shelf life of fruits and vegetables, the production of their powders is a promising approach with the advantages of reducing the expenditures of packaging, storage, and transportation, reducing the amount of waste, having a more stable form of the fruit and vegetables, increasing the economic potential, and the consumption areas such as nutraceutical industries.for these dehydration is an important unit operation for better preservation, long shelf life of vegetables by converting it into a dried powder form. these all vegetable powder served as regular diet and foods and also used in healthy nutritious preparation by making smoothies, mixing with chapatti and many more.

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