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Formulation and evaluation of gymnema soup mix for secondary complications of diabetes

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Abstract

Diabetes mellitus (DM) was characterized by chronic hyperglycemic condition occurs due to deficiency of insulin secretion or insulin action. Gymnema, the potent anti-diabetic medicinal plant was used in the treatment of diabetes by its bio active constituent called "Gymnemic acid". The untreated and long term type 2 diabetes leads to the secondary complications such as micro and macro vascular diseases. This complication could be overcome by the intake of adequate quantity of folate, magnesium, lutein and chromium rich food sources. Hence, the instant gymnema soup powder has been formulated to overcome secondary complications of diabetes. Totally nine combinations were formulated for instant gymnema soup mix powder. Along with gymnema different proportions of broccoli, pumpkin, moringa and banana powders were added to fulfil the nutrient inadequacy. The ingredients like pepper powder, cumin powder, dried onion slices, corn flour, skimmed milk powder and salt were added for flavour, taste and satiety. Based on the sensory evaluation, the combination C₁ scored best followed by C₅ and C₇ ranked the lowest score based on the quality attributes. In instant gymnema soup powder, the moisture, pH, protein, carbohydrates, ascorbic acid, magnesium and chromium contents were found to be 5.81%, 5.85, 20.05%, 57.00%, 30mg/100g, 368mg/100g, 572.02mcg/100g respectively.

Keywords: Gymnema, secondary complications, formulation of soup mix, nutrient analysis

1. Introduction

Diabetes mellitus was characterized by the elevated blood sugar level in the body resulting in altered metabolism of protein, fats and carbohydrates. It occurs due to the inability of the body to secrete insulin hormone or usage of insulin in effective manner. Lifestyle changes, environmental and genetic factors are the major cause for this increasing trend in diabetes (Oza *et al.*, 2016) [14]. Long term and untreated type 2 diabetes leads to the various secondary complications. The micro vascular complications includes neuropathy (nerve damage), nephropathy (kidney damage) and retinopathy (vision loss or eye damage). The macro vascular complication includes peripheral artery, cardio vascular and cerebro vascular diseases. The micro-vascular complications are higher in comparison with the macro-vascular diseases.

The medicinal plant "Gymnema" botanically called as *Gymnema sylvestre* was woody climbing in nature with the native of tropical forest of India. It has been used for thousands of years in the treatment of diabetes and various ailments. It mainly inhibits the sugar absorption in the body by blocking the receptors in the intestines. The main bio active constituent present in gymnema was "Gymnemic acid". It was mainly involved in the mechanism of regeneration of the beta cells in the pancreas, helps in the production of higher insulin hormone secretion. Dried herbal tea powder, soup mix and other beverages plays an important role in the nutrient balance and it is devoid of enzymatic and oxidative spoilage. The soup powders could be stored for long time without any changes in the stability. Within very short time it could be easily reconstituted and served with satiety.

With this background the instant gymnema soup powder has been developed along with the folate (Broccoli), lutein (Red pumpkin), magnesium (Moringa leaves) and chromium (Unripened nendran banana) rich food sources to overcome the onset of secondary complications of diabetes as it fulfils the inadequacy of above mentioned nutrients.

2. Materials and Methods**2.1. Selected vegetables, fruits and herbs****2.1.1 Gymnema**

It was the potent antidiabetic plant used in the treatment of diabetes and other complications. The bio active constituent called "Gymnemic acid" was mainly involved in the regeneration of pancreatic cells, higher insulin production and it increases the enzyme responsible for the

utilisation of glucose (Saneja *et al.*, 2010)^[18]. The gymnema leaves were dried for 2 hours at 50°C in cabinet dryer. The dried leaves were powdered and packed for storage study in different packaging materials like HDPE, aluminium foil pouches and Metallized polypropylene pouches.

2.1.2 Broccoli

It helps in the reduction of blood sugar level due to the compound called “Sulforaphane”. It was the richest source of folate and chromium. The broccoli florets were steam blanched for 3 minutes and dried in cabinet dryer for 5 hours at 60°C. The dried florets were milled and packed in different packaging materials.

2.1.3 Moringa

Moringa, the richest source of magnesium helps to treat type 2 diabetes with its beneficial antioxidants and bioactive compounds. The fresh leaves were collected, washed in clean tap water, and dried in cabinet dryer at 50°C for 2 hours. The leaves were milled and packed in different packaging materials for storage.

2.1.4 Red Pumpkin

It was rich in carotenoid contents like lutein and zeaxanthin. The supplementation of lutein protects against the diabetic retinopathy and lowers the oxidative stress. The firm fruits were selected and made in to uniform pieces after the removal of outer skin. The sliced fruits were steam blanched for 5 minutes until glazing occurs and dried in cabinet dryer (60 °c for 6 hours). The dried materials were milled and stored for

packaging study in different packaging materials.

2.1.5 Banana

The unripened nendran fruits were selected and water blanched for one hour. The rinds gets splitted and the skin turns black in colour during blanching process. The outer skin was removed, and sliced in to uniform pieces for dehydration. It was dried in cabinet dryer at 60°C for 3 ½ hours. The dried produces were milled and stored in different packaging materials for storage study

2.1.6 Optimization and formulation of gymnema soup powder

To combat the secondary complications of diabetes, nine different combinations (Table1) were made with the selected vegetables, fruits and herbs like gymnema, broccoli, red pumpkin, moringa leaves and unripened nendran banana. The combinations were tested for organoleptic evaluation with hedonic scale score card for the best sensory and quality attributes.

2.1.7 Optimization of ingredients

1. Soup powder - 5g (Equal proportions of gymnema, broccoli, moringa, and unripened nendran banana powders)
2. Spice and flavour - Pepper powder (1g), cumin powder (1g), dried onion slices (1g).
3. Taste improver - Salt (1.5g)
4. Thickening agents - Skimmed milk powder (2g) and corn flour (2g).

Table 1: Optimization and formulation of gymnema soup powder

S. No.	Combinations	Gymnema (%)	Broccoli (%)	Banana (%)	Pumpkin (%)	Moringa (%)
1.	C ₁	20	20	20	20	20
2.	C ₂	25	15	20	20	20
3.	C ₃	25	20	15	20	20
4.	C ₄	25	20	20	15	20
5.	C ₅	25	20	20	20	15
6.	C ₆	30	15	15	20	20
7.	C ₇	30	20	15	15	20
8.	C ₈	30	20	20	15	15
9.	C ₉	30	15	20	20	15

*C= Combinations of the treatment from 1 to 9

2.1.8 Reconstitution of gymnema soup mix

About 25g of soup powder was mixed with 350ml of water in a stainless steel vessel. It was boiled for 5 to 6 minutes, strained and served for 2 persons (Farzana *et al.*, 2017)^[6].

2.2. Physico chemical analysis

The nutrient content analysis of soup mix powder was estimated by determined methods. Moisture content (Ranganna, 1995)^[16], pH (Jayaraman *et al.*, 1976)^[8], protein (Lowry *et al.*, 1951)^[11], carbohydrates (Dubois *et al.*, 1956)^[3], Ascorbic acid (Sadasivam and Balasubramanian., 1987)^[17], Magnesium (Titrimetric method) was estimated by the determined method. The chromium content in the samples

was determined by the wet digestion method (Ajlec *et al.*, 1988)^[1]. The biochemical analysis of dried sources and soup mix powder was given in the table 3 and 4 respectively.

2.3. Sensory evaluation of soup mix

The organoleptic evaluation was done with 15 panelist number using hedonic scale score card. It ranges from 1 to 9, in which 1 stands for “Dislike extremely” and 9 stands for “Like extremely”. The sensory parameters like appearance, taste, flavour, texture, colour and over all acceptability were tested. The combinations which scored best would be analysed for nutrient estimation and subjected to storage study (Table 2).

Table 2: Sensory evaluation of gymnema soup mix powder

S. No	Sensory parameters	C1 (9)	C2 (9)	C3 (9)	C4 (9)	C5 (9)	C6 (9)	C7 (9)	C8 (9)	C9 (9)
1.	Appearance	9.00	9.00	9.00	9.00	9.00	8.80	8.70	8.73	8.83
2.	Taste	8.80	8.50	8.45	8.30	8.82	7.95	6.95	7.80	8.00
3.	Flavour	8.95	8.90	8.45	8.00	8.92	7.70	7.65	7.80	7.90
4.	Texture	8.96	7.80	8.50	8.50	8.60	7.65	8.30	8.35	8.00
5.	Colour	9.00	8.50	8.43	8.00	8.90	7.50	7.60	7.80	7.90

6.	Overall acceptability	8.90	8.68	8.67	8.44	8.85	7.92	7.84	8.08	8.13
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*C= Treatment combination, where 9 is the 9 point hedonic scale range

1. Disliked extremely
2. Disliked very much
3. Disliked moderately
4. Disliked slightly
5. Neither liked or disliked
6. Liked slightly
7. Liked moderately
8. Liked very much
9. Liked very extremely

3. Statistical analysis

The design of the experiment Factorial Completely Randomized Design (FCRD) was followed. The impact of storage and packaging materials were analysed during the

storage of instant gymnema soup powder.

4. Results and Discussion

The physico chemical analysis of dried sources and formulated gymnema soup powder was elucidated in table 3 and 4. The first combination (C₁) containing gymnema, broccoli, red pumpkin, moringa leaves and unripened nendran banana powder in equal proportions with flavouring and thickening agents showed highest score (table 2) followed by C₅ based on the organoleptic evaluation. The combination C₇ ranked the lowest one due to the higher concentration of moringa and gymnema powder. Increasing the concentration of gymnema powder increased the bitterness of the soup.

Table 3: Physico chemical analysis of the sources on dry weight basis

S. No	Sources	pH (%)	Moisture Content (%)	Protein (g/100g)	Carbohydrates (g/100g)	Ascorbic acid (mg/100g)	Magnesium (mg/100g)	Chromium (mcg/100g)
1.	Gymnema	6.34	6.67	4.30	52.50	25.60	350.00	1700
2.	Broccoli	5.70	3.40	2.40	50.00	40.25	16.80	8.00
3.	Moringa	6.01	7.01	26.60	33.40	102.00	398.00	BDL
4.	Pumpkin	4.60	5.90	6.20	64.00	10.65	42.00	BDL
5.	Banana	5.56	6.26	2.01	36.20	13.58	98.00	4.00

*BDL= Below detection limit

Table 4: Bio chemical analysis of instant gymnema soup powder

S. No.	Parameters	Values per 100g
1.	pH	5.85 ± 0.252582
2.	Moisture content (%)	5.81 ± 0.185916
3.	Protein (g)	20.05 ± 0.388566
4.	Carbohydrates (g)	57.00 ± 1.536235
5.	Ascorbic acid (mg)	30.00 ± 0.984315
6.	Magnesium (mg)	368.00 ± 1.459527
7.	Chromium (mcg)	572.02 ± 2.634616

* Values are means of 3 replicates. It was expressed as mean ± standard deviation

Moisture content

The moisture content of the selected vegetables, fruits and herbs varied from 3.40 (Broccoli) to 7.01% (Moringa) and that of gymnema soup powder it was found to be 5.81%.

Kamble *et al.* (2019) [10] evaluated that, the moisture content of soup powder made of herbs supplemented with moringa pod was found to be 10.81% while Chandramouli *et al.* (2012) [4] reported the moisture content of nutritional herbal soup powder of about 7.2%. The moisture content of instant gymnema soup powder was significantly lower when compared with the above studies. The lesser the moisture content it could be stored for prolonged period. When moisture content exceeds above 14%, it leads to mold growth and clustering and could not be stored for longer period (Ozturk *et al.*, 2019) [15].

pH

The pH value of the selected vegetables, fruits and herbs varied from 4.60 (Pumpkin) to 6.34 (Gymnema) and that of formulated gymnema soup powder it was found to be 5.85.

Kamble *et al.* (2019) [10] stated that the pH value of soup mix incorporated with moringa pod powder with herbs was found to be 6.5 while Niththiya *et al.* (2014) [13] recorded 5.56 in vegetable based soup mix powder and 6.52 in prawn soup powder.

Protein

The protein content of the selected vegetables, fruits and herbs varied from 2.01 (Banana) to 26.60g/100g (Moringa) and that of formulated gymnema soup powder was found to be 20.05 g/100g.

Anita *et al.*, (2016) [2] stated that, the protein content of nutritional soup mix powder was found to be 9.74 g/100g and that of commercial soup powder it was recorded as 6.52 g/100g. The protein content of instant gymnema soup mix powder was significantly higher in comparison with the above study. This may be due to the addition of moringa leaves to the soup mix powder. The leaves of moringa were rich in protein, vitamins and minerals. It contains many nutritional and medicinal properties and is also rich in beneficial antioxidants (Farzana *et al.*, 2017) [6].

Carbohydrates

The carbohydrate content of the selected vegetables, fruits and herbs varied from 33.40 (Moringa) to 64.00g/100g (Pumpkin) and that of formulated soup powder it was found to be 57g/100g.

Mohamed *et al.* (2020) [12] reported that, the carbohydrate content of formulated instant soup mix powder was found to be 56.89 g/100g in mixture I and 54.16 g/100g in mixture II. The carbohydrate content of instant gymnema soup mix

powder was significantly higher. This may be due to the addition of pumpkin flour as it was rich in carbohydrates, minerals and fibre content (Dhiman *et al.*, 2017)^[5]. The fibre content in pumpkin cannot be broken down to sugar molecules and thus helps to keep the blood sugar in check and hence regulate blood sugar in body.

Ascorbic acid

The ascorbic acid content of the selected vegetables, fruits and herbs varied from 10.05 (Pumpkin) to 102.00mg/100g (Moringa) and that of formulated gymnema soup powder it was found to be 30.00mg/100g.

Farzana *et al.* (2017)^[6] reported that the vitamin c content of soup mix incorporated with soy, mushroom and moringa flour was found to be 6.4mg/100g. The gymnema soup powder has shown to have higher ascorbic acid content due to the incorporation of moringa leaf powder.

Magnesium

The magnesium content of the selected vegetables, fruits and herbs varied from 16.80 (Broccoli) to 398.00mg/100g (Moringa) and that of formulated gymnema soup powder it was found to be 368 mg/100g.

Shanthini *et al.*, (2018)^[19] reported that the magnesium content of instant ridge gourd peel soup mix was observed as 345 mg/100g. The results indicated that the magnesium content of gymnema soup mix powder was significantly higher in comparison with the above study. This may be due to the addition of moringa leaves which was rich in minerals like iron, magnesium, calcium and potassium and plays an effective role in treating malnutrition (Gopalakrishnan *et al.*, 2016)^[7].

Chromium

The chromium content of the selected vegetables, fruits and herbs varied from 4.00 (Banana) to 1700mcg/100g (Gymnema) and that of formulated gymnema soup powder it was found to be 572.02 µg/100g.

Jayasinghe *et al.* (2016)^[9] have reported chromium content of vegetables formulated seaweed extract soup powder was recorded as 80 µg /100g in formulation 2. The present study of gymnema soup mix powder has shown to contain higher amount of chromium in comparison with the above study. Chromium deficiency leads to impaired glucose function. The adequate intake of chromium regulates the action of insulin and also plays a role in the breakdown of glucose.

5. Conclusion

Gymnema, the potent anti diabetic plant has been used in various forms like tablet, energy supplements, herbal tea, beverages etc., for the management of diabetes. It helps to fight the cravings of sugar and it lowers the blood glucose level. In an attempt to prevent and combat the onset of secondary complications of diabetes like neuropathy, nephropathy and retinopathy, the instant gymnema soup powder has been developed along with rich sources of folate, lutein, magnesium and chromium. Due to the inadequacy of above mentioned nutrient rich sources it leads to various complications of diabetes. The gymnema soup powder containing the above nutrient rich food sources fulfills the adequacy of lacking nutrients and prevents the secondary complications of diabetes. Hence it would be the appropriate choice to fulfill the nutritional demand and helps in the alleviation of secondary complications of diabetes. The major

advantage was the stability of the soup powder could be maintained at the normal room temperature for a year without enzymatic and oxidative spoilage.

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