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Appraisal on nutritional profile and food product development incorporating *Solanum nigrum* leaf and berries powder as an ingredient

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ABSTRACT

The use of herbal preparations remained the main approach of folk medicine to the treatment of ailments and debilitating diseases. *Solanum nigrum*, well- known medicinal herb found in India that is used to treat various ailment of the body. The objective of the study is to evaluate the nutritional profile of leaf and berries of *Solanum nigrum* and food product development based on their powder as an ingredient. The nutritional profile (moisture, crude ash, protein, crude fat, crude fibre, carbohydrate, calcium and iron content) of *Solanum nigrum* were analyzed with AOAC standard protocols. Food products such as Mathri, Namkeen and Square Bite were developed by incorporating leaf and berries powder at 10% and 15% levels and were organoleptic evaluated through Discriminative and Communicative panel. The study results showed that leaf contain significantly higher content of protein (24.16%), ash (7.79%), crude fibre (29.01%), fat (0.59%) and calcium (19.06%) as compared to berries of *Solanum nigrum* at P=0.05. Organoleptic evaluation showed that developed products at 10% level of incorporation of both leaf and berries powder were highly accepted and registered insignificant difference at P=0.05 when compared to their respective standards. The study may conclude that *Solanum nigrum* leaf and berries both contain appreciable amount of nutrients and could be incorporated in food formulation.

Key Words : *Solanum nigrum,* Nutritional Profile, Organoleptic evaluation, Food products

INTRODUCTION

Medicinal plants play a significant role in providing primary health care services to rural people and are used by about 80% of the marginal communities around the world. These plants have played an essential role in the development of human culture because many of the modern medicines are produced from medicinal plants. Each medicinal plant species has its own nutrient composition besides having pharmacologically important phytochemicals. These nutrients are essential for the physiological functions of human body and have an important role in satisfying human needs for energy and life processes (Dingman, 2002).

The plant *Solanum nigrum* is commonly known as black night shade in English, Makoi in

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Hindi, Kachchipandu in Telugu, Munatakali in Tamil, Piludi in Gujarati and Kamuni in Marathi, belongs to the *Solanaceae* family (Jimoh *et al.,* 2010). It is an annual weed that grow up to 60 cm tall, branched, erect, usually grows in moist habitats in different kinds of soil, including dry, stony, shallow, or deep soils, crop fields. It can be cultivated in tropical and subtropical agro climatic regions. The stem may be smooth or bear small hairs (trichomes), the flowers usually white in colour, have five regular parts and are up to 0.8cm wide. The leaves are alternate, opaque, ovate, smooth, finely hairy, matt and dark in colour with irregularly toothed wavy margin. The berries are globular, dark green, matt berries and matt black when ripe, which contain many flattened finely pitted, yellow to dark brown woody seeds approximately 1.5 mm long.

It has an extensive range of medicinal value due to the presence of protein, vitamins and minerals and variety of natural bioactive compounds such as steroidal lactones, glycosides, alkaloids and flavonoids. Thus, it is commonly used in Ayurvedic medicine in India as tonic or supplement for the treatment and prevention of metabolic disorders. The fruits are used as a tonic, laxative, appetite stimulant; and also for treating asthma and "excessive thirst" (Al-Daihan, 2008). It is also used in the oriental systems of medicine for various purposes as an antitumorigenic, antioxidant (Lee and Lim, 2003), anti-inflammatory (Zakaria *et al.,* 2006) hepatoprotective (Raju *et al.,* 2003) and antipyretic agent (Kaushik *et al.,* 2009). Hence, in the light of the above research facts, the present investigation was undertaken with the objective to appraise the nutritional profile and food product development incorporating *Solanum nigrum* leaf and berries powder as an ingredient.

METHODOLOGY

Sample collection and preparation of powder:

The leaf and berries of *Solanum nigrum* were collected from the Krishi Vigyan Kendra of Bulandshahr, Uttar Pradesh. The leaves and berries were washed in tap water and shade dried after which they were reduced into fine powder by grinding and packed into air tight container for further analysis.

Nutritional profile:

Nutritional profile was carried out in accordance with Association of Official Analytical Chemists (AOAC, 2005). This constitutes the different classes of nutrients present in the samples such as Moisture content was determined by drying in an oven at 85^0C to constant weight. Crude ash content was determined by weight difference after sample mineralization at 600°C for 6 h. Crude protein was determined indirectly from the analysis of total nitrogen (Crude Protein= Amount of Nitrogen x 6.25) using Kjeldhal method by Kel Plus analyzer (Pelican, Model: KES-061). Crude fat was determined through Socs Plus system (Pelican, Model: SCS-6) by using petroleum ether. Crude fiber content of samples were determined by digesting dry sample with 1.25% H_2SO_4, followed by 1.25% NaOH solution in Fibra Plus Fiber analyzer (Pelican, Model: FES-4) and Carbohydrate content was determined by subtracting the content of protein, moisture, ash, fiber and fat from 100 and vitamin C was estimated by titrimetric method.

Mineral elements estimations indicate the amount of inorganic elements present in the sample. The determination was carried out using standard procedures. Mineral such as Iron (Fe) was determined by Wong's method and Calcium (Ca) by titration against standard potassium permanganate solution (Sharma, 2007).

Product development:

In the present study, three food products such as Mathri, Namkeen and Square Bite were developed with by incorporating the leaf and berries powder at 10% and 15% levels.

Sensory evaluation:

The evaluation of the developed food products were carried out by using 5 point composite scale with respect to various attributes namely; appearance, color, texture, odor and taste whereas overall acceptability was assessed by 9-point hedonic rating scale.

Statistical analysis:

The results obtained were expressed as Mean ±SD and Paired t-Test of three determinations and also statistically analyzed to ascertain its significance. The significance was determined at (p=0.05 level).

RESULTS AND DISCUSSION

Table 1 and Fig. 1 shows nutritional profile analysis for moisture, ash, protein, fat, crude fiber, carbohydrate content and minerals (calcium and iron) content. Moisture content (g/100g) of *Solanum nigrum* leaf and berries powder was 14.61±0.56 and 9.36±0.61, respectively. This data illustrate that leaf had significantly increased value by 37.9% at p=0.05 levels when compared with berries. Similar study conducted by Ali *et al.* (2016) have stated that *Solanum nigrum* leaf contain 9.6g/100g of moisture whereas data reported by Eze and Kanu, 2014 that berries of *Solanum aethopicum* contain 6.69±0.02g/100g of moisture content. However, low moisture content is encouraged to safeguard the product from microbial attack and enzymatic action and therefore prevent spoilage (Akonor *et al.,* 2016). Ash content is a reflection that the fruits are rich in mineral elements. *Solanum nigrum* leaf had significant higher ash content (10.15±0.01g) as compared to berries (8.19±0.01g) by 7.79% at p=0.05 level which was comparable to the data given by Akubugwo *et al.* (2007) that *S. nigrum* leaf contains 10.18±0.02g/100g of ash content. According to Oyeyemmi *et al.* (2015) that berries of *Solanum anguivi* had 8.89±0.02g of ash content which is an agreement

Table 1: Nutritional analysis of *Solanum nigrum* leaves and berries on dry weight basis.

Parameters	*Solanum nigrum*	
	Leaf	Berries
Moisture(g/100g)	14.61±0.56	9.36±0.61*(37.9%↓)
Ash(g/100g)	10.15±0.01	8.19±0.01*(7.79%↓)
Fat(g/100g)	5.27±0.11	$5.04±0.47^{NS}$ (0.59%↓)
Crude Fibre(g/100g)	8.72±0.04	6.19±0.03* (29.01%↓)
Protein(g/100g)	28.55±0.36	21.65±0.19* (24.16%↓)
Carbohydrate(g/100g)	32.09±0.03	49.57±0.04* (51.72%↑)
Iron(mg/100g)	11.04±0.01	12.09±0.02* (9.51%↑)
Calcium(mg/100g)	18.46±0.08	14.94±0.05* (19.06%↓)

Values are expressed as Mean ±SD of triplicate determinations compared with *Solanum nigrum* leaf and berries powder on dry weight basis. * Shows significant difference at ($p \geq 0.05$) level; NS shows non-significant difference at ($p \leq 0.05$) level

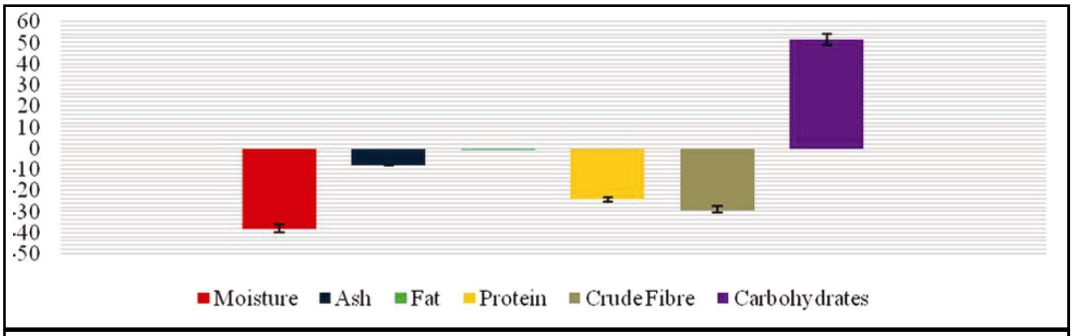

Fig. 1 : Present difference of *Solanum nigrum* leaf and berries powder with moisture, ash, protein, fat, crude fiber and carbohydrate

to the present study.

Fat content (g/100g) of *Solanum nigrum* leaf and berries powder were 5.27±0.11 and 5.04±0.47, respectively. Leaf had higher value as compared to berries which was significantly increased by 0.59% at p=0.05 level. The fat value reported by Ibiam and Nwigwe (2013) that leaf of *Solanum aethiopicum* contain lower value (1.39±0.01) then data observed by the present study. Likewise, the study reported by Oyeyemi *et al.* (2015) that the berries of *Solanum anguivi* contain 5.68±0.05g/100g of fat content. Crude fat are the major source of energy but should be consumed with caution so to avoid obesity and other related diseases. The low fat content would favor prevention of metabolic disorders such as cardiovascular diseases, diabetes and cancer (Showemimo and Olarewaju, 2004). Crude fiber content (g/100g) was 8.72±0.04 in leaf which was significantly increased by 29.01% when compared with berries (6.19±0.03) at p=0.05 level. Similar data reported by Bamishaiye *et al.* (2011) that leaves of *Moringa oleifera* had 8.20±0.02g of fibre content which is agreement with the obtained data. Crude fibre content obtained for berries was 3.99g/100g of *Solanum torvum* reported by Akoto *et al.* (2015). Intake of dietary fibers may lower the serum cholesterol level and chances of having the risk of coronary heart disease, hypertension, constipation, diabetes, colon and breast cancer (Jain *et al.,* 2011).

Protein content (g/100g) of *Solanum nigrum* leaf and berries were 28.55±0.36 and 21.65±0.19, respectively. The data shows that leaf were significantly increased by 24.16% when compared with berries at p=0.05 level. The result obtained comparably higher with the leaves of *Ficus capensis* (17.47g/100g) reported by Uzoekwe and Mohammed (2015). Whereas, Eze and Akubor (2012) have reported that fruit of *Abelmoschus esculentus* had 25.1±0.01g/100g of protein. Proteins are not generally known to be higher in fruits but they are of primary importance because they are enzyme that catalyzes chemical reactions and accelerates some chemical reactions (Gbile and Adesina, 2009). Carbohydrate content (g/100g) of *Solanum nigrum* leaf and berries powder were 32.09±0.03 and 49.57±0.04, respectively. The data indicates that berries were significantly increased by 51.72% at p=0.05 levels when compared with leave. According to Adebisi and Oyeleke (2009) that leaf and fruit of *Ficus carpensis* had 30.93g/100g and 25.69g/100g of carbohydrate content.

The results of mineral composition revealed that leaf and berries of *Solanum nigrum* constitute a good source of calcium and iron content. The result obtained for iron content (mg/100g) was significantly lower in *Solanum nigrum* leaves (11.04±0.01) by 9.51% as compared to berries (12.09±0.02) at P=0.05 level. The result obtained compared favorably with leaf of *Ipomoea batatas* (9.62mg/100g) reported by Owusu *et al.* (2008). According to Aberoum and Deokule (2009) that

berries *Solanum indicum* had 11.0mg/100g of iron content which is agreement with the present study. The calcium content of *Solanum nigrum* leaves and berries (mg/100g) were 18.46±0.08 and 14.94±0.05, respectively. The data indicates that leaves value was significantly increased by 19.06% at P=0.05 level. Similar data given by Ibiam and Nwlgwe, 2013 that leaf of *Solanum aethiopicum* contain 16.01mg/100g of calcium whereas data reported by Sambo *et al.* (2016) that berries of *Solanum incanum* contain 15.00±0.03mg/100g of calcium. Thus, Minerals content analysis revealed that iron and calcium that are required for bone development and hemoglobin production (Adeyeye and Otakiti, 1999) is higher in *Solanum nigrum* leaf and berries.

Figure 2 showed that Organoleptic evaluation for overall acceptability of developed products such as Mathri, Namkeen and Square bite at 10% and 15% level of incorporation of leaf and berries powder of *Solanum nigrum*. The results showed that developed products *viz*., Mathri, Namkeen and Square bite at 10% level of incorporation of leaves and berries powder were highly accepted and comparable with their standard products and registered insignificant difference at P=0.05. Similarly, a study conducted by Singh, 2016 that cakes were developed by the incorporation of fruit pulp of *Ananas cosmosus* at 5%, 10% and 15% and showed that cakes with 5% and 10% incorporation of *Ananas cosmosus* fruit pulp powder were highly accepted by the panel members.

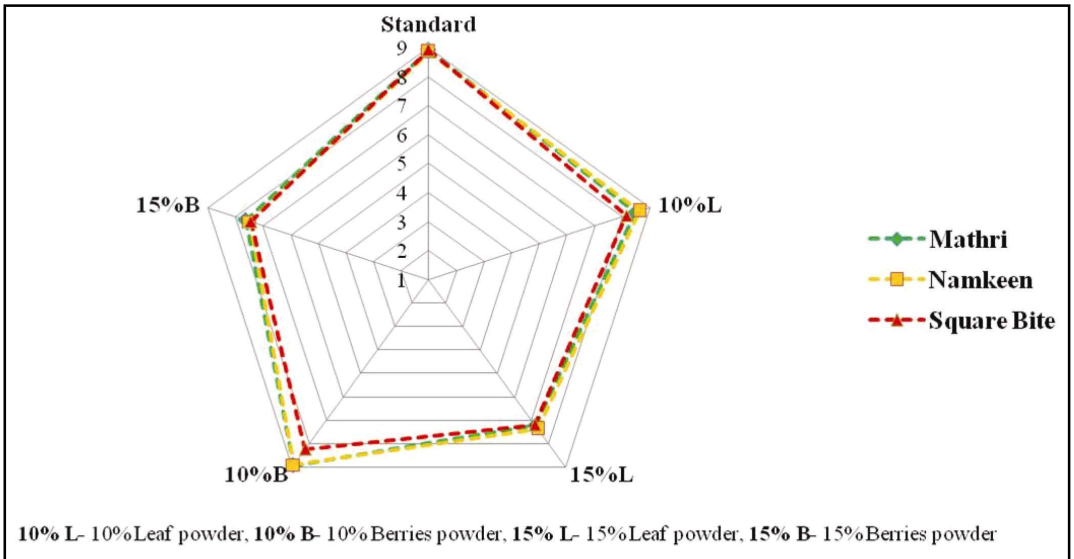

Fig. 2: Overall acceptability evaluation of food products (Mathri, Namkeen and Square Bite) developed by *Solanum nigrum* Leaf and berries powder as an ingredient in the terms of sensory attributes

Conclusion :

The study showed that leaf and berries of *Solanum nigrum* had superior nutritional as well as sensory characteristics. Therefore, it can be used as a valuable ingredient for the preparation of food products which may serve as a good nutritional spring in combating malnutrition.

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