Studies on physico chemical characteristics of Gymnema sylvestre (Leaf, powder and extract)

Dipak Sharma, AR Sawate, BM Patil and RB Kshirsagar

Abstract

Gymnema sylvestre is a reputed herb in the ayurvedic system of medicine. The herb exhibits a broad range of therapeutic effects as an effective natural remedy for diabetes. The mandate of current study was to explore the nutritional and anti diabetic worth of Gymnema sylvestre because of its easily availability and mostly use. The fresh Gymnema sylvestre leaves were green in colour and elliptical in shape. The average weight, length and width of leaves were 0.157, 4.46 and 2.56 respectively. The physico-chemical characteristics of Gymnema sylvestre powder like bulk density (g/ml), tapped density (g/ml), Carr's index, Hausner's ratio, pH 1% solution, acid insoluble ash (%), water soluble ash (%), water-soluble and alcohol soluble extractive values (%) were 0.43, 0.54, 20.37, 1.255, 6.93, 1.95, 2.60, 17.23 and 4.57 respectively. The proximate composition of Gymnema sylvestre powder like moisture, crude fat, crude protein, crude fiber, total ash and total carbohydrate contents were 7.38, 5.80, 11.50, 9.49 and 54.89 per cent respectively. The minerals calcium, magnesium, chromium, zinc, copper and iron were analyzed from Gymnema sylvestre powder, the concentration of these minerals were 1542.63, 592.40, 2.70, 21.80, 12.71 and 36.91 (mg/100g) respectively. Gymnema sylvestre liquid extract had a brownish green colour, no specific odour and bitter in taste while dried extract was brown in colour and also bitter in taste. The physico-chemical characteristics of Gymnema sylvestre dried ethanolic extract like pH 1% solution, saponin test, foaming index, ash content (%), water soluble fraction (%), water-insoluble fraction (%) and gymnemic acid content (%) were 6.8, positive, less than 100, 1.90, 65, 35 and 8.00 respectively.

Keywords: Gymnema sylvestre, Physico-chemical characteristics, Proximate composition, Minerals, Gymnemic acid.

1. Introduction

In India diabetic patient are increasing day by day and according to world diabetic foundation it has the world’s largest diabetes population, followed by China with 43.2 million and it has major concern among health experts and national and international healthcare. World health organization (WHO) has identified diabetes as an epidemic condition and one of the major killers of the decade. Estimation by WHO, there will be about 250 million cases of diabetes mellitus throughout the world by 2025 (Mishra, 2011)[24]. The fresh leaves of Gymnema sylvestre when chewed have the remarkable property of paralyzing the sense of taste of sweet substance for some time (Gent, 1999) [13]. The atomic arrangement of gymnemic acid molecules is similar to that of glucose molecules. These molecules fill the receptor locations on the taste buds thereby preventing its activation by sugar molecules present in the food. This prevents craving for sugar. Similarly, Gymnemic acid molecules fill the receptor location in the absorptive external layers of the intestine thereby preventing the sugar molecules absorption, which results in low blood sugar level (Sahu et al., 1996) [30]. Traditionally it was recommended for stomach problems, constipation, liver disease but the recent studies have shown that the extract of Gymnema sylvestre is useful in controlling blood sugar to treat type-II diabetes (NIDDM). When Gymnema leaf extract is administered to a diabetic patient it stimulates the pancreas to increase release of insulin (Persaud et al., 1999)[30].

Crude or low molecular weight Gymnema sylvestre extracts have been reported to have antidiabetic effect in alloxan or streptozotocin treated animals by raising plasma insulin levels and attenuating blood glucose responses during oral glucose/sucrose tolerance tests (Okabayashi et al., 1990 and Terasawa et al., 1994) [28]. Similarly, crude or low molecular weight Gymnema sylvestre extracts have been reported to have hypoglycemic effects in patients with hyperglycemic diabetes (Khare et al., 1983 and Baskaran et al., 1990) [18, 6]. Clinical studies investigating antidiabetic effects have typically used 200 or 400 mg extract daily standardized to contain 25% gymnemic acids (Baskaran et al., 1990; Joffe et al., 2001 and Preuss et al., 2004)[6, 18, 32].
Though Gymnema sylvestre has been used for several centuries and considered to be safe, there is a paucity of data on interaction between Gymnema and pharmaceuticals or minerals. Even US FDA also states some of the illness and injuries associated with the use of dietary supplements (USFDA, 1993) [44].

Materials and methods
The present investigation was carried out in Department of Food Engineering, College of Food Technology, VNMKV, Parbhani. Fresh Gymnema sylvestre (gudmar) leaves were obtained from the CFT, Parbhani.

Preparations of Gymnema sylvestre (gudmar) leaf powder
Gymnema sylvestre (gudmar) leaf powder was prepared as per the method given by Farzana and Muhammad (2010) [11].

Preparations of Gymnema sylvestre (gudmar) leaf extract
Gymnema sylvestre leaf extract was prepared as per the method adopted by Killedar et al., (2012) [19]. Leaf powder (500 g) was extracted by 70 per cent ethanol extraction method with boiling on water bath for 1 hour and cooled extract was filtered through vacuum filtrations unit, evaporated to dryness on rotary film vacuum evaporator. The dried extract was kept in refrigerator for future use.

Proximate analysis of Gymnema sylvestre (gudmar) powder
Analysis of Gymnema sylvestre powder for moisture, crude fat, crude protein, crude fiber, total ash and total carbohydrates content were carried out according to their respective methods (A.O.A.C., 2005). All the tests were executed in triplicates.

Mineral Estimation of Gymnema sylvestre (gudmar) powder
The determination of calcium, magnesium and iron were done as per the method described by Ranganna (1986). The Atomic Absorption Spectrophotometer was used to determine chromium, zinc and copper content in Gymnema sylvestre powder as per the method given by Ramachandra et al., (2012).

Results and Discussion
Table 1: Physical properties of fresh Gymnema sylvestre (gudmar) leaf

<table>
<thead>
<tr>
<th>Physical parameters</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Color</td>
<td>Green</td>
</tr>
<tr>
<td>Shape</td>
<td>Elliptical</td>
</tr>
<tr>
<td>Average Weight (g)</td>
<td>0.157*</td>
</tr>
<tr>
<td>Average Length (cm)</td>
<td>4.46*</td>
</tr>
<tr>
<td>Average Width (cm)</td>
<td>2.56*</td>
</tr>
</tbody>
</table>

*Each value is an average of three determinations
The average weight of fresh gudmar leaves was 0.157 g, length and width of gudmar was measured by using vernier calliper which gives idea about the wholesomeness of the leaves and the length and width was found to be 4.46 cm and 2.56 cm respectively. These results were in good agreement with the results reported by Pandey and Yadav (2010) [29]. The shape and color was observed visually and the shape of leaf was found to be elliptical and color was green. Similar results reported by Kumar et al., (2015) [20, 21].

The color of gudmar powder was observed visually and found to be green in colour. The pH 1 per cent solution of gudmar powder was 6.93. The values of bulk density (g/ml) and tapped density (g/ml) were 0.43 and 0.54 respectively. Tapped powder was 6.93. The values of bulk density (g/ml) and tapped density (g/ml) were 0.43 and 0.54 repectively. Tapped density gives information on consolidation of a powder. A consolidated powder is likely to have a greater arch strength than a less consolidated one, and may therefore be more resistant to powder flow. *Gymnema sylvestre* had values 20.37 and 1.255 respectively for Carr's index and Hausner’s ratio indicating fair compressibility. Similar results with respect to bulk density, tapped density, Carr's index and Hausner’s ratio were reported by Tripathi et al., (2013) [43].

The values of acid insoluble ash and water soluble ash were 1.95 and 2.60 per cent respectively. A high ash value is indicative of contamination, substitution, adulteration, or carelessness in preparation of powder. These values were found to be reasonably low indicating low contamination. Water-soluble ash is the part of the total ash content, which is soluble in water. It is a good indicator of extraction of water-soluble salts during preparation of extract. Thus, it is the difference in weight between the total ash and the residue obtained after treatment of total ash with water. These values were in good agreement with the results reported by Kalidass and Mohan (2010) [27] and Dwivedi et al., (2012) [9].

Water-soluble and alcohol soluble extractive values play an important role in evaluation of properties of powder. Less extractive value indicates addition of exhausted material, adulteration or incorrect processing during drying or storage or formulating. The values of Water soluble extractive and alcohol soluble extractive were 17.23 and 4.57 per cent respectively. It was observed that the water-soluble extractive values were higher than alcohol-soluble extractives. The results for the water-soluble and alcohol soluble extractive values were supported by finding of Chiranjaneevi et al., (2013) [7]. The results of proximate composition revealed that gudmar powder is good source of carbohydrate, crude fiber, protein and ash content. Table 3 revealed that moisture content in gudmar powder was found to be 7.38 per cent and the fat content was low in concentration i.e. 5.80 per cent. Gudmar powder contained higher amount of carbohydrate (54.89 per cent) than other parameters. Crude fiber, protein and ash content of gudmar powder were found to be 11.50, 10.94 and 9.49 per cent respectively. These all chemical parameters are similar with results found in Goel and Tarvinderjeet (2013) [14].

**Table 2**: Physico-chemical properties of *Gymnema sylvestre* (gudmar) powder

<table>
<thead>
<tr>
<th>Physico-chemical parameters</th>
<th>Results*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Color</td>
<td>Green</td>
</tr>
<tr>
<td>Bulk Density (g/ml)</td>
<td>0.43</td>
</tr>
<tr>
<td>Tapped Density (g/ml)</td>
<td>0.54</td>
</tr>
<tr>
<td>Carr's Index</td>
<td>20.37</td>
</tr>
<tr>
<td>Hauser's Ratio</td>
<td>1.255</td>
</tr>
<tr>
<td>pH 1% solution</td>
<td>6.93</td>
</tr>
<tr>
<td>Acid insoluble ash (%)</td>
<td>1.95</td>
</tr>
<tr>
<td>Water soluble ash (%)</td>
<td>2.60</td>
</tr>
<tr>
<td>Water soluble extractive values (%)</td>
<td>17.23</td>
</tr>
<tr>
<td>Alcohol soluble extractive value (%)</td>
<td>4.57</td>
</tr>
</tbody>
</table>

*Each value is an average of three determinations

Minerals are inorganic elements needed by the body as structural component and regulators of body processes. The macronutrients (Ca, Mg, Cr, Zn and Cu) and Micronutrient (Fe) were analyzed from gudmar powder, the concentration of these minerals were 1542.63, 592.40, 2.70, 21.80, 12.71 and 36.91 (mg/100g) respectively. The values of calcium, magnesium, zinc and copper were similar with the results reported by Dey and Khaled (2015) [8] while results of chromium and iron are in good agreement with Goel and Tarvinderjeet (2013) [14]. The concentration of Ca and Mg were found much higher than the other inorganic minerals. Chromium was found very low as compared to other minerals.

Calcium is reported to play an important role in glucose tolerance factor (GTF), which decreases the blood glucose level by utilising insulin (Gurson and Saner, 1971). Calcium content of *Gymnema sylvestre* was higher than the value reported by Goel and Tarvinderjeet (2013) [14]. Chromium is a critical cofactor in the action of insulin (Anderson, 1997) [5] and an active component of the glucose tolerance factor (GTF). Deficiency of chromium has been implicated as one of the causes of diabetes mellitus and risk factor in atherosclerotic disease (Anderson, 1995) [4]. Chromium content in *Gymnema sylvestre* analysed in the present study was higher than the value reported by Ray et al., (2004) [37] but lower than that reported by Naga Raju et al., (2006) [26], Copper possesses insulin-like activity and it has been found that its deficiency leads to glucose intolerance, decreased insulin response and increased glucose response (Mooradian and Morely, 1987) [25]. Zinc plays an important role in production, storage, and regulation of insulin. Zinc levels tend to be low in diabetic patients (Garg et al., 2005) [12]. Naga Raju et al., (2006) [26] have determined zinc content of *Gymnema sylvestre* as 2.89 mg/100 g dry weight. Iron is a strong pro-oxidant that catalyses several cellular reactions that result in the production of reactive oxygen species (ROS),
with a consequent increase in the level of oxidative stress (Puntarulo, 2005) [31]. This contributes to tissue damage that may potentially elevate the risk of type 2 diabetes. Serum ferritin levels (marker of body iron stores) positively correlate with levels of circulating insulin, glucose and also with dyslipidemia (Ramakrishnan et al., 2002 and Tilbrook, 2004) [32]. The concentration of iron in Gymnema sylvestre was higher than that found by Ray et al., (2004) [33] and lower than the value reported by Naga Raju et al., (2006) [20].

Results presented in Table 5 with respect to physical characteristics of extract revealed that colour and odour of liquid extract was brownish green and no specific smell was observed. Similar results were reported by Chiranjeevi et al., (2013) [7]. Liquid extract had a brownish green colour, it had no specific odour and bitter in taste while dried extract was brown in colour and also bitter in taste. Both liquid and dried extract were smooth in touch. Gudmar liquid and dried extract were bitter in taste may be due to the presence of gymnemic acid. Gymnemagenin (group of gymnemic acids) is bitter in taste. Studies show that gymnemagenin-a peptide from Gymnema sylvestre, block the ability to sweet taste or bitter flavors and thus reduces sweet carvings (Ninomiya and Imoto, 1995; Pierce, 1999 and Saneja et al., 2010) [27] [31] [39]. Bitter taste of Gymnema sylvestre was reported by Syedy and Nama (2014) [40].

Table 5: Physical characteristics of Gymnema sylvestre (gudmar) leaf extract

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Liquid Extract</th>
<th>Dried Extract</th>
</tr>
</thead>
<tbody>
<tr>
<td>Color</td>
<td>Brownish green</td>
<td>Brown</td>
</tr>
<tr>
<td>Taste</td>
<td>Bitter</td>
<td>Bitter</td>
</tr>
<tr>
<td>Odour</td>
<td>No specific</td>
<td>No specific</td>
</tr>
<tr>
<td>Touch</td>
<td>Soft</td>
<td>Soft</td>
</tr>
</tbody>
</table>

The results of physico-chemical properties of dried ethanolic extract revealed that the pH of gudmar dried extract was 6.8 and ash content 1.90 per cent respectively. The ethanolic extract of Gymnema sylvestre was further sub fractionated into water soluble (W-S) fraction and water-insoluble (W-INS) fractions by the method reported by Alam et al., (2005) [3]. The ethanolic extract was stirred in distilled water at room temperature and filtered to give water-soluble (W-S) fraction and water-insoluble (WINS) fractions. The yield obtained of W-S and W-INS were 65 per cent and 35 per cent respectively in terms of total ethanolic extract. The foaming index was determined on the basis of method given by WHO (1998) [43] and value obtained was less than 100. The values of all physico-chemical parameters were similar with results found in Kumar et al., (2014) [22]. The result of saponin test was found positive, it indicated the presence of saponins in dried gudmar extract. Similar results of saponin test were reported by Kumar and Husain (2015) [20, 21]. The gymnemic acid content was found 8.00 per cent in 70 % ethanolic extracted dried gudmar extract. The result expressed was in good agreement with Killeedar et al., (2012) [19].

Table 6: Physico-chemical properties of Gymnema sylvestre (gudmar) dried extract

<table>
<thead>
<tr>
<th>Properties</th>
<th>Dried extract</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH (1% solution)</td>
<td>6.8</td>
</tr>
<tr>
<td>Ash (%)</td>
<td>1.90</td>
</tr>
<tr>
<td>Water soluble (W-S) fraction (%)</td>
<td>65</td>
</tr>
<tr>
<td>Water-insoluble (W-INS) fraction (%)</td>
<td>35</td>
</tr>
<tr>
<td>Foaming Index</td>
<td>less than 100</td>
</tr>
<tr>
<td>Saponin test</td>
<td>Positive</td>
</tr>
<tr>
<td>Gymnemic acid content (%)</td>
<td>8.00</td>
</tr>
</tbody>
</table>

*Each value is an average of three determinations

Conclusion

Gymnema sylvestre had values 20.37 and 1.255 respectively for Carr's index and Hausner’s ratio indicating fair compressibility of powder. Gymnema sylvestre found rich source of nutrients. Gymnema sylvestre powder had good amount of carbohydrate (54.89 per cent), protein (10.94 per cent) and crude fiber (11.50 per cent). Gymnema sylvestre dried extract was found to be higher in calcium (1542.63 mg/100g), magnesium (592.40 mg/100g) and iron content (36.91 mg/100g). Calcium is reported to play an important role in glucose tolerance factor (GTF), which decreases the blood glucose level by utilising insulin. Gymnema sylvestre dried extract had 65 per cent water soluble (w-s) fraction that make it suitable to utilize in liquid food products also. Gymnema sylvestre (leaf, powder and extract) is beneficial to the diabetic patients with regards to its antidiabetic activity (8 per cent gymnemic acid content in dried extract) and nutritional status specially mineral contents.

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