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# Estimation of Nutritive Indices in Eight Lamiaceae Plants of Manipur

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## ABSTRACT

Eight edible Lamiaceae plants belonging to subfamily Nepetoideae found in Manipur were investigated for their macronutrients and mineral elements. All the estimated parameters were studied on dry weight basis. Available carbohydrates, total soluble protein, total amino acid content and minerals were estimated. All the selected plants recorded different amount of biochemical compounds and minerals. Total soluble sugar, reducing sugar and non reducing sugar ranged from 2.55 to 10.90, 0.40-1.68 and 0.33-9.38 mg $g^{-1}$ while total amino acid, crude protein and total soluble protein ranged 1.90-8.63, 157.50-43.74 and 31.60-17.60 mg $g^{-1}$, respectively. These plants were also found to have significant quantity of minerals. *E. blanda* and *O. americanum* recorded higher values in K (27.25 mg $g^{-1}$) and N (25.20 mg $g^{-1}$). Higher concentrations of Fe (2.56 mg $g^{-1}$) and Mn (0.15 mg $g^{-1}$) were recorded in *E. communis* (white flower) while higher values of P (5.25 mg $g^{-1}$) and Zn (0.28 mg $g^{-1}$) were observed in *E. stachyodes*. Among the plants studied, *O. basilicum* revealed to contain higher values in 3 elements-Mg (7.33 mg $g^{-1}$), S (1.27 mg $g^{-1}$) and Ca (7.64 mg $g^{-1}$), respectively. The present study will provide information on dietary values of these eight selected herbs of Lamiaceae commonly utilized by Manipuris.

**Key words:** Lamiaceae, Nepetoideae, minerals, biochemicals, dietary values

## INTRODUCTION

Since time immemorial, additional sources of valuable nutrients and minerals are provided by many herbs that are not provided by the conventional vegetables and fruits. These herbs supplied interesting flavors and negligible amount of calories to human diet (Pachkore *et al*., 2010). Also, various minerals present in plants play important role in human nutrition (Prasad and Bist, 2011). Lamiaceae includes several aromatic herbs represented by 236 genera and 7172 species (Harley *et al*., 2004) which play significant roles to humans. They contain valuable pool of multifarious chemical compounds having different biological activity depending on the structural composition (Harley and Reynolds, 1992). Due to presence of these chemicals, plant derived medicines are also used for treatment of many diseases for their lesser side effects and better compatibility (Karim *et al*., 2011). Members of this family comprise a rich storehouse of photochemicals including flavonoids, phenolic acid and terpenoids which can be exploited for its antimicrobial activities, food preservatives, insect repellants and therapeutic purposes (Palsson and Jaenson, 1999; Karanika *et al*., 2001; Sokovic *et al*., 2009; Matkowski and Piotrowska, 2006; Mishra and Mishra, 2011).

The state of Manipur is one of the North-Eastern states of India which is a part of Indo-Myanmar hotspot regions of the world (Myers *et al.*, 2000). It harbours around 40 genera and 104 species of Lamiaceae with some of them commonly used by the people of Manipur for various utilities especially as culinary herbs due to its aromatic nature. These herbs have been grown since the dawn of civilization and popularity increases for their ability to act as flavouring agents in various food items (Zheng and Wang, 2001). All plants have its own nutritional composition besides having pharmacologically important phytochemicals. Among these, macronutrients like carbohydrate and proteins play an important role as a source of energy and also in satisfying human needs for different life processes. Although, nutritional contributions of many herbs are thought to be negligible, they complement human diet in addition with many other important pharmaceutical and healthcare products. For nutritional and toxicological analyses in foodstuffs, the macro and micro elements are usually determined (Cabrera *et al.*, 2003). The consumption of these plants provides several minerals required by human body. In this line, the present experiment was taken up with an idea to find out the carbohydrates, amino acids, protein and elemental constituents of eight taxa of edible Lamiaceae plants.

## MATERIALS AND METHODS

The study was carried out during the period of 2006-2009. The seeds of eight taxa of Lamiaceae shown in Table 1 and Fig. 1 under the subfamily Nepetoideae were collected locally and planted in experimental fields. Among them, *H. suaveolens* is widespread as a noxious weed and reported to have medicinal values (Devi *et al.*, 2008) while the seven other plants are widely cultivated and used as culinary herbs in Manipur. Specimens were identified and the vouchers were deposited at Manipur University Museum of Plants (MUMPS), Department of Life Sciences, Manipur University. The aerial parts of these plants were collected just before the flowering time. The collected samples were shade dried and ground into powder form by a grinder.

**Estimation of carbohydrates, amino acids and proteins:** Different methods were followed for estimation of total soluble sugar, reducing sugars and non-reducing sugars. Total soluble sugar was estimated following the method of Dubois *et al.* (1951). Reducing sugars were estimated following the method of Nelson (1944) as modified by Smogyi (1952). Estimation of non reducing sugar was done following Malhotra and Sarkar (1979). The total free amino acid was estimated by the method of Yemm and Cocking (1955). The crude protein content in plant sample was estimated by Kjeldahl Method (Gupta, 2006) and the total soluble protein content was estimated by the method of Lowry *et al.* (1951).

Table 1: Eight selected edible taxa of Lamiaceae with their local names and voucher numbers

| Species | Local name | Voucher No. |
|---|---|---|
| *Elsholtzia blanda* Benth. | Kanghuman | 004302 |
| *E. communis* (Coll. and Hemsl.) Diels var. purple flower | Lomba | 004328 |
| *E. communis* (Coll. and Hemsl.) Diels var. white flower | Lomba | 004301 |
| *E. stachyodes* (Link) Raizada and Saxena | Tekta | 004303 |
| *Hyptis suaveolens* Poit. | Tukma | 004311 |
| *Ocimum americanum* L. | Mayangba | 004313 |
| *O. basilicum* L. | Naoseklei | 004312 |
| *Perilla frutescens* L. | Thoiding angouba | 004309 |

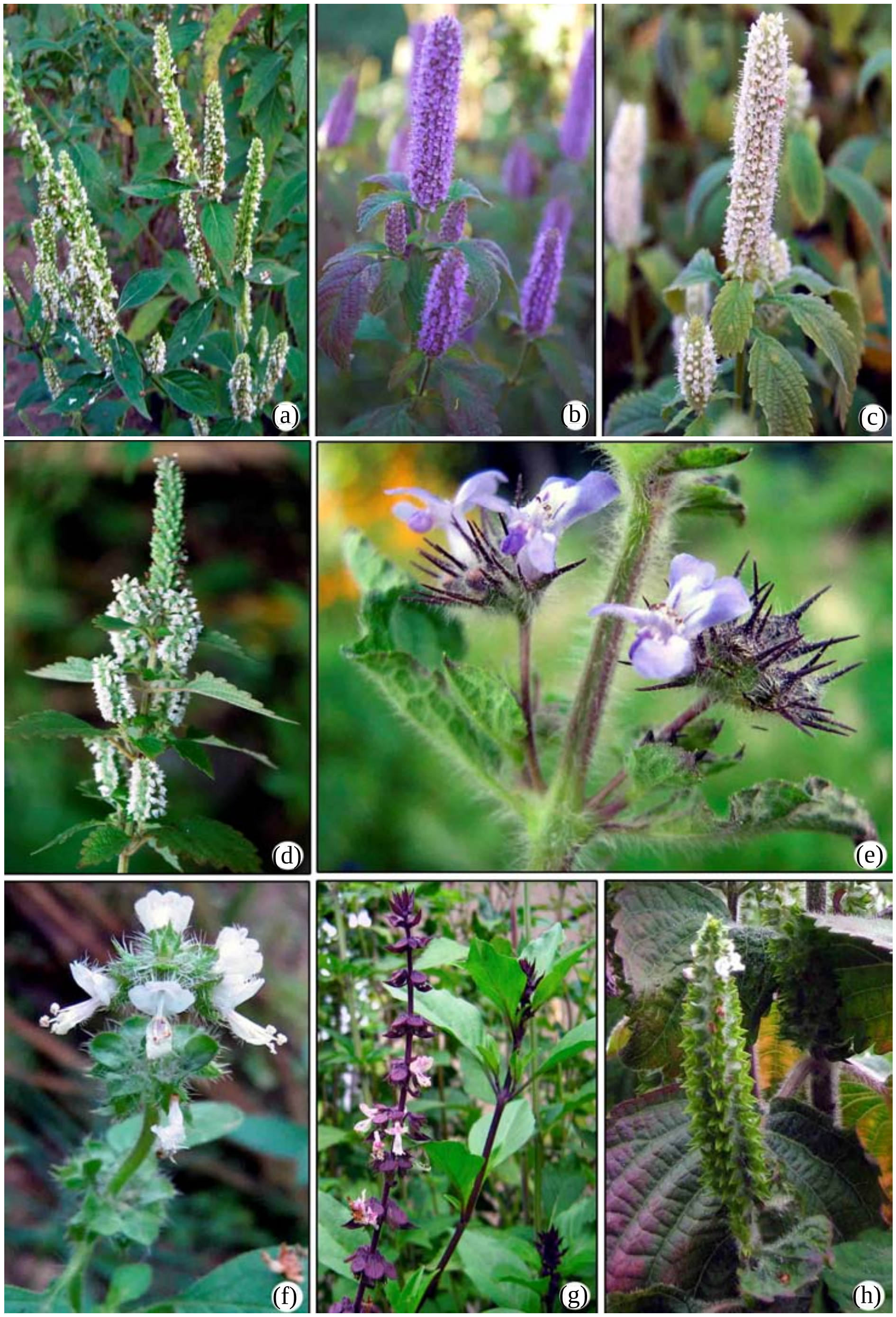


Fig. 1 (a-h): Habit photographs, (a) *Elsholtzia blanda* Benth, (b) *E. communis* (Coll. and Hemsl.) Diels var. purple flower, (c) *E. communis* (Coll.and Hemsl.) Diels var. white flower, (d) *E. stachyodes* (Link) Raizada and Saxena, (e) *Hyptis suaveolens* Poit., (f) *Ocimum americanum* L., (g). *O. basilicum* L. and (h) *Perilla frutescens* L.

**Estimation of minerals:** Wet diacid digestion method of Capar *et al.* (1978) was followed for the analysis of different minerals. K was estimated in a systronics-105 flame photometer. Sulphur and Phosphorus were estimated in a UV-VIS double beam Spectrophotometer following the procedures described by Murthy (2006) and Gupta (2006). Ca, Mg, Mn, Zn, Fe, Cu and Co was analyzed in a Parkin Elmer atomic absorption spectrophotometer, Analyst AA-200.

**Statistical analysis:** Each parameter was replicated three times. The mean values and their respective Standard Error Means (SEM) with significance differences were calculated by performing ANOVA test with the help of SPSS (9).

## RESULTS AND DISCUSSION

It was found that out of the eight edible plants taken up for nutrient and mineral element contents, all of them showed different quantities in all the parameters studied. The carbohydrate contents (total soluble sugar, reducing sugar and non reducing sugars), total soluble amino acid and protein (crude protein and total soluble protein) contents in the selected taxa are given in Table 2. It was observed that the total sugar ranged from 2.01±0.122 in *Elsholtzia stachyodes* (Fig. 1d) to 10.90 mg $g^{-1}$ in *Perilla frutescens* (Fig. 1h). The maximum and minimum reducing sugar content ranged from 1.68 mg $g^{-1}$ in *E. stachyodes* to 0.40 mg $g^{-1}$ in *H. suaveolens* (Fig. 1e). The values of non reducing sugar varied from 0.33 mg $g^{-1}$ in *E. stachyodes* to 9.38 mg $g^{-1}$ in *P. frutescens*. Kavitha *et al.* (2009) evaluated the total sugar in 37 genotypes of *Coleus forskohlii* grown in Tamil Nadu and Karnataka and reported total sugar content in the range of 59.0-100.3 mg $g^{-1}$. The values of total amino acid varied from 1.90 mg $g^{-1}$ in *H. suaveolens* to 8.63 mg $g^{-1}$ in *E. communis* var. purple flower (Fig. 1b). Higher values of crude protein (157.50 mg $g^{-1}$) and the total soluble protein content (31.60 mg $g^{-1}$) were found in *O. americanum* (Fig. 1f) while minimum values of crude protein (43.74 mg $g^{-1}$) and soluble protein (17.60 mg $g^{-1}$) were recorded in *P. frutescens* respectively (Table 2). Variable amounts of protein content in *Teucrium* (64.7 to 438 mg $g^{-1}$) were reported by Juan *et al.* (2004). Kavitha *et al.* (2009) reported crude protein content in the range of 61.4-90.5 mg $g^{-1}$ in 37 genotypes of *Coleus forskohlii.* However, crude protein in the hybrids of *O. gratissimum* ranged from 91.90 to 179.40 mg $g^{-1}$ (Edeoga *et al.*, 2006) which agrees with the present results.

Table 2: Available carbohydrates, proteins and amino acid contents (Mean±SEM; n = 3) in mature aerial parts of some Lamiaceae (mg $g^{-1}$)

| | Available carbohydrates | | | | Proteins | |
|---|---|---|---|---|---|---|
| Species | Total soluble sugar | Reducing sugar | Non reducing sugar | Amino acids | Crude protein | Total soluble protein |
| *Elsholtzia blanda* | 7.14±0.087 | 1.41±0.087[a,b] | 5.73±0.020 | 5.38±0.327[a] | 104.20±0.312 | 26.10±0.238[d,e] |
| *E. communis* var. purple flower | 3.62±0.091[a] | 1.44±0.077[a] | 2.18±0.056 | 8.63±0.327 | 131.24±1.083 | 29.80±1.19[a] |
| *E. communis* var. white flower | 4.27±0.060 | 1.28±0.059[b,c] | 2.99±0.025[a] | 7.05±0.433 | 96.21±0.756 | 24.70±0.519[c,e,f,g] |
| *E. stachyodes* | 2.01±0.122 | 1.68±0.032[d] | 0.33±0.091 | 3.69±0.418[b] | 61.28±0.571 | 24.00±0.896[d,f,h] |
| *Hyptis suaveolens* | 3.05±0.096[a] | 0.40±0.025 | 2.65±0.071[a,b] | 1.90±0.293[c] | 113.74±0.962 | 26.40±0.814[b] |
| *Ocimum americanum* | 3.88±0.135 | 1.12±0.036[c,e] | 2.70±0.102[b] | 3.92±0.311[b] | 157.50±0.381 | 31.60±0.750 |
| *O. basilicum* | 2.55±0.100 | 1.22±0.071[e] | 1.33±0.031 | 5.26±0.251[a] | 87.49±0.417 | 24.60±0.568[a,b,d,g,h] |
| *Perilla frutescens* | 10.90±0.084 | 1.50±0.066[a,d] | 9.38±0.018 | 2.11±0.205[c] | 43.74±1.228 | 17.60±0.513 |

Different letters between taxa denote significant differences (LSD, $p<0.05$)

Table 3: Elemental constituents (Mean±SEM; n = 3) in mature aerial parts of some Lamiaceae plants (mg g$^{-1}$)

| Elements | *Elsholtzia blanda* | *E. communis* var. purple flower | *E. communis* var. white flower | *E. stachyodes* | *Hyptis suaveolens* | *Ocimum americanum* | *O. basilicum* | *Perilla frutescens* |
|---|---|---|---|---|---|---|---|---|
| P | 1.99±0.078$^{a}$ | 4.56±0.0656$^{a}$ | 4.56±0.5132 | 5.25±0.141 | 2.45±0.178 | 3.38±0.045$^{c}$ | 3.58±0.225$^{b,c}$ | 3.87±0.136$^{b}$ |
| K | 27.25±0.243 | 13.25±0.174 | 8.60±0.287$^{a,b}$ | 6.83±0.318 | 8.50±0.0178$^{b,c}$ | 12.50±0.146 | 9.50±0.341 | 8.40±0.193$^{a,c}$ |
| N | 16.80±0.050 | 21.00±0.173 | 15.40±0.082 | 9.80±0.086 | 18.20±0.154 | 25.20±0.061 | 14.00±0.067 | 7.00±0.197 |
| Mg | 4.11±0.070 | 6.49±0.169$^{a,b}$ | 6.58±0.276$^{b,c}$ | 5.95±0.055$^{c}$ | 5.50±0.308$^{d}$ | 6.12±0.205$^{b}$ | 7.33±0.141 | 5.49±0.136$^{b}$ |
| S | 0.87±0.09$^{b,c,d}$ | 1.03±0.031$^{a}$ | 1.05±0.032$^{a}$ | 1.03±0.053$^{a}$ | 0.88±0.061$^{b,c}$ | 0.87±0.043$^{c,d}$ | 1.27±0.025 | 0.83±0.02$^{b,d}$ |
| Ca | 3.41±0.045 | 4.97±0.083 | 4.47±0.104 | 6.01±0.067$^{b,c}$ | 6.18±0.061$^{a,b}$ | 6.30±0.112$^{a}$ | 7.64±0.228 | 5.91±0.111$^{c}$ |
| Fe | 0.82±0.06 | 1.94±0.020 | 2.56±0.020 | 1.06±0.003$^{a}$ | 1.04±0.084$^{a}$ | 2.02±0.010 | 1.56±0.012 | 1.32±0.009 |
| Cu | 0.03±0.003$^{a}$ | 0.03±0.003$^{a}$ | 0.04±0.003$^{b}$ | 0.05±0.009$^{c}$ | 0.04±0.003$^{b}$ | 0.04±0.003$^{b}$ | 0.05±0.003$^{c}$ | 0.04±0.006$^{b}$ |
| Co | 0.03±0.009$^{a,c,d}$ | 0.05±0.006$^{b,c}$ | 0.05±0.003$^{b,c}$ | 0.05±0.003$^{b,c}$ | 0.02±0.000$^{c}$ | 0.03±0.003$^{a,c,d}$ | 0.05±0.003$^{b,c}$ | 0.04±0.003$^{d}$ |
| Mn | 0.03$^{a}$±0.009$^{a}$ | 0.12±0.003$^{c,d}$ | 0.15±0.009$^{c}$ | 0.03±0.000$^{a}$ | 0.03±0.006$^{a}$ | 0.07±0.006$^{b}$ | 0.07±0.006$^{b}$ | 0.09±0.005$^{d}$ |
| Zn | 0.09±0.009 | 0.13±0.003$^{b}$ | 0.11±0.003 | 0.28±0.006 | 0.18±0.009$^{a}$ | 0.14±0.003$^{b}$ | 0.17±0.000$^{a}$ | 0.18±0.001$^{a}$ |

Different letters between taxa denote significant differences (LSD, $p<0.05$)

Trace elements are essential for enzymatic processes of biological systems and these elemental requirements are obtained by human body from different sources, the major source being the plants. The elemental constituents in the eight plants within the studied taxa are given in Table 3. Potassium (K) and nitrogen (N) were found to be the most abundant elements in these plants. The primary role of potassium (K) is its capacity to maintain water balance in plant cells and its content in plants varied from 1.58-3.75%. In the present study, *E. blanda* (Fig. 1a) (27.25 mg g$^{-1}$) represented maximum K content and minimum by *E. stachyodes* (6.83 mg g$^{-1}$). Nitrogen (N) content in plant ranges from 1.5-4% and is one of the most important macro-elements in plants for being an important constituent of amino acids, proteins, nucleic acids, co-enzymes, pigments, alkaloids and vitamins (Popovic *et al*., 1998). The contents of N varied from 9.80 mg g$^{-1}$ in *E. stachyodes* to 25.20 mg g$^{-1}$ in *O. americanum* whereas Phosphorus (P) content ranged from 1.99 mg g$^{-1}$ in *Elsholtzia blanda* to 5.25 mg g$^{-1}$ in *E. stachyodes*. Sulphur (S) content was found maximum in *O. basilicum* (Fig. 1g) (1.27 mg g$^{-1}$) and minimum in *P. frutescens* (0.83 mg g$^{-1}$) however, Calcium (Ca) and Magnesium (Mg) ranged from 3.41 mg g$^{-1}$ in *E. blanda* to 7.64 mg g$^{-1}$ in *O. basilicum* and 7.33 mg g$^{-1}$ in *O. basilicum* to 1.99 mg g$^{-1}$ in *E. blanda* (Table 3).

The micronutrients were found in trace quantities and the amounts of differences among the selected plants were less. The main features of Iron (Fe) are its polyvalence and chelating capability. Its content was found maximum in *E. communis* var. white flower (Fig. 1c) and minimum in *E. blanda* (0.82 mg g$^{-1}$). Zinc (Zn) activates to more than 300 enzymes and influences many metabolic processes in the living cell. Zinc which is the only element present in all the six classes of enzymes is found to be the second most abundant transition metal in organisms after iron (Fe) (Broadley *et al*., 2007). *E. stachyodes* showed maximum Zn content (0.28 mg g$^{-1}$) while *E. blanda* recorded minimum content (0.09 mg g$^{-1}$). These findings were in agreement with the earlier reports that plants contain Zn in the range of 0.25-1.20 mg g$^{-1}$. Cobalt (Co) is known to be responsible for a number of vital metabolic processes and its distribution in plants reported to be in the range of 0.0001-0.0010 mg g$^{-1}$ (Jaleel *et al*., 2009). Co content ranged from 0.02 mg g$^{-1}$ in *H. suaveolens* to 0.05 mg g$^{-1}$ in *E. communis* var. purple flower, *E. communis* var. white flower, *E. stachyodes* and *O. basilicum* while Copper (Cu) content ranged from 0.03 mg g$^{-1}$ in *E. blanda* and *E. communis* var. purple flower to 0.05 mg g$^{-1}$ in *E. stachyodes* and *O. basilicum*. Manganese is one of the microelements which are actively absorbed by the plants and have a significant effect

Table 4: Dietary reference standards for macronutrients and elements in human adult*

| Nutrients/Elements | Recommended daily intake for adult |
|---|---|
| Carbohydrate‡ | 130 g |
| Protein‡ | 46-56 g |
| Potassium | 3500 mg |
| Calcium | 800 mg |
| Phosphorus | 800 mg |
| Magnesium | 280-350 mg |
| Zinc (Zn) | 12-15 mg |
| Iron (Fe) | 10-15 mg |
| Manganese | 2-5 mg |
| Copper (Cu) | 1.5-3 mg |
| Cobalt (Co) | 7-15 μg |

*NRC (1989); ‡Zello (2006)

on the formation of plant mass. Mn content ranged from 0.03 to 0.15 mg $g^{-1}$ while the minimum is recorded in *E. blanda, E. stachyodes* and *H. suaveolens* and the maximum value being found in *E. communis* var. white flower. Beck *et al.* (2006) reported Mn content in *Satureja hortensis* to be 0.097 mg $g^{-1}$. As Mn being one of the elements having multi-functional activities especially for its anti-oxidant capacity, the present finding of 0.15 mg $g^{-1}$ Mn content in *E. communis* var. white flower seems to be promising for commercial exploitation. In the case of other elements, the present findings are in agreement with the reports of Kadifkova-Panovska *et al.* (1997) wherein the amount of K was found to be the highest (18.24 mg $g^{-1}$) followed by Ca (4.71 mg $g^{-1}$) and Mg (3.41 mg $g^{-1}$) with significant quantities of Fe (0.72 mg $g^{-1}$), Mn (0.203 mg $g^{-1}$) and Cu (13.19 mg $g^{-1}$). Mineral contents of these plants are comparable with the data provided by several workers in various vegetables (Al-Naqeep *et al.*, 2009; Saupi *et al.*, 2009; Ihedioha and Okoye, 2011; Seal, 2011). Ultimately, the significant amount of nutritional and elemental values in the selected plants under study will help in meeting the dietary requirements of human health with the recommended daily intake for human adult given in Table 4.

## CONCLUSION

In the present study, the eight selected plants of Lamiaceae commonly taken by the people of Manipur as culinary herbs are found to have significant amount of carbohydrates, amino acids, proteins and minerals. These nutrients and elemental constituents have significant and specific roles inside our body and recommended for daily consumption. The selected taxa were found to have more amounts of proteins than carbohydrates. So, these plants will provide an important additional food item to those ailing people who abstained from taking higher amounts of carbohydrates. The nutritional contributions of these selected herbs will complement human diet in addition to many other important pharmaceutical and healthcare products. As an overall, regular intake of these plants will help in supplementation of nutritional values and minerals required inside our body and to protect from various ailments.

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