Nutritive investigation of plants used in dietetics: with special reference to Yoga

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The present study estimated the nutritive values and proximate analysis of some plants used in Ayurveda which are commonly available in the local market of Bangalore. Most of the plants evaluated are used as vegetable in the daily life of the local inhabitants of Bengaluru and adjoining area as recorded in our earlier study. Proximate analysis was done such as estimation of proteins, carbohydrates, vitamin C, calcium, iron, zinc, vitamin B1, B2, B3, fat, calories, crude fiber and other minerals. This paper also covers about the importance of Ahara in “Yoga” which is an age old tradition and has become one of the major holistic approaches for the management and well being around the globe. Apart from the physical activities it is also important to have a healthy and ‘Satvik’ diet which also includes vegetables and fruits. Plants mentioned as diet in classical Ayurvedic literatures also possesses broad spectrum of therapeutic activity. Some of the plants are also used as dietetics and consumed by different populations in India. The results revealed that all the vegetables and fruit selected in the study exhibits high calorific value, vitamin C, iron, etc. which are essential for the development of body.

Keywords: Yoga, Ayurveda, Crude fiber, Proximate analysis, Satvik ahar, Vitamin

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‘Yoga’ is an ancient physical, mental and spiritual practice originated from India. The word “Yoga” derived from a Sanskrit word ‘Yuj’ which means union, or yoke, to join, or to unite, symbolizing the union of body and consciousness. The importance and popularity of “Yoga” worldwide can be understood by the endorsement and practice of a large number of countries and their population of the world. Owing to its universal appeal, the United Nations proclaimed 21st June as “International Day of Yoga” by resolution 69/131, on December 11, 2014, which was aimed to raise attentiveness on many benefits of practicing yoga worldwide. Proposal to celebrate the “International Day of Yoga” was placed before the United Nations by Indian Prime Minister Shri Narendra Modi. The draft resolution made by India was endorsed by a record 175 member states. The practice of Yoga regularly promotes endurance, strength, characteristics of friendliness, compassion, and most importantly self-control. Such practices are very important not only for physical well-being but also for the mental and spiritual well-being of a person. It is also very interesting that Yoga, breathing exercises (praanayam), along with meditation can enhance the quality of life, reduce stress and promote healing process in cancer patients, more importantly, to reduce stress which is a prerequisite for the tumor enhancement.

The importance of yoga is also very clearly defined by the great leader for the humanity of all times swami Vivekananda as “All the orthodox systems of Indian Philosophy have one goal in view, the liberation of the soul through perfection. The method is by Yoga”.

In the practice of Yoga, intake of nutrition plays a very important role which is obtained from the daily “satvik” food taken by the practitioner and it is essential to know nutritional values. It is well said in ancient Hindu mythology that “what we eat, what we become”. Food in any form is the source of energy for the human, animals and plants present on this earth, either the food or sources of energy may be different but the ultimate product is the energy in any of the cases. Various classical texts of yoga such as

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“Gheranda samhitha” and “Hatha pradipika” has been written about the different food articles which should be consumed by a Yoga practitioner (Sadhaka). It was also described that practicing yoga without controlling the diet may harm a practitioner or lead to various diseases. In the yogic diet number of vegetables and fruits are included. The Gheranda samhitha which is one of the well recognized texts of “Hath Yoga” is considered as the most encyclopaedic text for “Hath Yoga” and gives a detail about the importance of the vegetables which should be consume by the practitioner of yoga.

He may eat green, fresh vegetables (बाळशाक), black vegetables (कालशाक), the leaves of patola, the Vastukau-saka, and hima-locika saka. These are the five sakas (vegetable leaves) praised as fit food for Yogi.

Ayurveda the ‘Ancient Science of Life’ also encourages the use of fruits and vegetables. Plants are utilized as a source of food medicine and fodder from long back. India has a well established traditional system of medicine with a rich Materia Medica which includes herbals, animal and mineral products. The use of herbs in India can be traced back to the Vedic times, the Rigveda (200-1000 BC), mentions the names of some medicinal herbs while the Atharva Veda provides a more detailed account on herbs, for the treatment of several important diseases.

Considering these facts and potential of the dietary supplements for the vitality of the human body, studies was conducted by CCRAS and our group to scientifically evaluate the nutritional profiling of number of plants used in dietetics. One of such study conducted by our group (funded by Karnataka Janana Ayoga) revealed that medicinal plant markets exist alongside vegetable markets in Bangalore. Interestingly the medicinal plant’s vendors bring the medicinal plants based on the demand from community to these markets and are sold during early morning (4.00 am to 6.00 am). A total of 57 medicinal plants were collected from 27 different markets and it was observed that there is a high demand for some of the important plants like Upodika (Basella soppu) Basella alba, (leaf and stem), Kadali (Bale kaayi and bale hoo) Musa × paradisiaca (Unripened banana and inflorescence), Parpataka (Shakre soppu), Mollugo oppositifolia (whole plant) and Goraksha (Gorikaayi)-Cyamopsis tetragonoloba (pods) (the gum of this is commonly known as Guar gum) and also for other plants like Agastya (Agase soppu) flower and leaves, Sesbania grandiflora, and Kaage soppu/ Kaachisoppu - Solanum nigrum (whole plant).

The comparative proximate analysis was carried out on leaf and stem of Basella alba L., pods of Cyamopsis tetragonoloba (L.) Taub., whole plant powder of Mollugo oppositifolia L., fruits and inflorescence of Musa × paradisiaca and three other variety of, i.e., Musa × paradisiaca var. karpooora bale, Musa × paradisiaca var. nendra bale and Musa × paradisiaca var. kalyana bale were used. The pictorial evidence of the plants is presented in Fig. 1.

Methodology

Procurement of plant samples

The fresh samples of Upodika (Basella alba L.), (leaf and stem), Kadali - Musa × paradisiaca L. (unripened banana and inflorescence), Parpataka bheda (Shakre soppu) – Mollugo oppositifolia L.

Fig. 1- Figures showing the vegetables and fruits, a: Basela alba L.; b. Cyamopsis tetragonoloba (L.) Taub.; c. Mollugo oppositifolia L.; d. Musa paradisiaca L. (fruit) Var. Karpooora bale; e. Musa paradisiaca L. (fruit) var. nendra bale; f: A plant.
(whole plant) and Goraksha (Gorikaayi) - *Cyamopsis tetragonoloba* (L.) Taub. (pods) were collected from different vegetable markets of Bangalore (KR Puram, Krishna Rajendra and Jayanagar). The botanical identification of these plants were done by taxonomist of NADRI, Bangalore and voucher specimens were deposited in RRCBI Herbarium Bangalore (Specimen No. - 12357- *Basella alba* L.; 12359, 12360, 12361 - *Musa* × *paradisiaca* L.; 12362- *Cyamopsis tetragonoloba* (L.) Taub.; 12358 - *Mollugo oppositifolia* L.).

**Profiling of nutritional values**

To carry out nutritional analysis, all the plant material were shade dried, powdered and selected nutritional parameters like proteins, carbohydrates, vitamin C, calcium, iron, zinc, vitamin B1, B2, B3, fat, calories, crude fiber, moisture, minerals, etc., were carried out by using standard protocols.

**Results**

The results of the nutritional analysis revealed that the selected plants had potential nutritive properties. Moisture content in all the samples was found below 12. Out of all the plant species, the crude fibers was found highest (64 % w/w) in the pods of *Cyamopsis tetragonoloba* (L.) Taub. followed by *Mollugo oppositifolia* L. (22.4 % w/w) and the least amount of fibres were present in *Musa paradisiaca* var. *nendrabale* (1.4 % w/w). The comparative results of crude fibres are mentioned in Fig. 2.

The results also revealed that the use of some of these plants is very beneficial in the daily diet due to high calorific values. The maximum calorific value was observed in the *Karpoora* variety of the *Musa paradisiaca* fruit (361.5 kcal/100 gm) and the lowest value was found in the *Cyamopsis tetragonoloba*. The details of calorific values are represented in Fig. 3.

It is very clear from the results that there is a marginal difference is present among the plant studied and most of the plants have good calorific values. Vitamin C was also found in all the plant samples, most of the plants exhibits the vitamin C below 50 mg/100 gm but surprisingly it was noted that the vitamin C content was highest in the *Mollugo oppositifolius* L.

Iron, which is the essential part of several proteins in the body and plays a vital role in many metabolic reactions. The leaves of *Basella alba* L. having high contents of iron and it was found in the range of 1.76-27.6. However, the lowest iron was found in the *Musa paradisiaca* L. var. *nendrabale*. Iron plays a vital role in many metabolic reactions which indicated that the leaves of *Basella alba* L. are good sources of iron as compared to the RDA (recommended dietary allowance) of iron. In infants, the RDA for iron is 11 mg/day, for children it’s 7-10 mg/day, for males 8-11 mg/day, for females 8-18 mg/day and 27 mg/day during pregnancy.

Subsequently the RDA for vitamin C for infants is 40-50 mg/day; children 15-45 mg/ day; adolescent its 75 mg/day (male), 65 mg/day (female); adult males 90 mg/day, adult females 75 mg/day and 80-85 mg/day during pregnancy, and 115-120 mg/day during lactation respectively. Apart from the above said parameters
different minerals such as calcium, magnesium, and zinc also estimated and it was found that some of the minerals were found in very high quantity.

Calcium is essential for nerve impulse conduction and activates some enzymes, which generates neurotransmitters; it is an important component of a healthy diet and a mineral necessary for life. It plays an important role in building strong and dense as well as in the keeping of healthy bones and teeth. The highest concentration was found in Mollugo oppositifolia L. (1693 mg/100 gm) followed by Besella alba L. and lowest calcium concentration was present in Musa paradisiaca L. (fruit) var. nendrabale (8.56 mg/100 gm).

The concentration of zinc was variable in different plants highest amount of zinc was found in Mollugo oppositifolia L. (43.2 mg/100 gm) and lowest concentration was observed in Musa paradisiaca L., different enzyme systems in the body require mineral zinc as a cofactor. These enzyme systems are responsible for every major physiological function that necessitates catalytic activity from enzyme at the molecular level. The details of different minerals and vitamins present in various medicinal plants used in Ayurveda are represented in Table 1. The results of the study clearly evident that all the plants evaluated showed the significant amount of nutritional element. The Ayurvedic medicinal plants found rich in nutritional composition and rich in the mineral composition.

Discussion

Diet rich in fibre, cereals, fruits and vegetables are considered very beneficial for the healthy life. The consumption of diets containing such products has potential to decrease the risk of various diseases due to their effect of increasing the fecal bulk, reducing intestinal transit time, cholesterol & glycemic levels and also entrap some mutagenic & carcinogenic agents which can be harmful to human. Dietary fibres have a potent role in maintaining the consistency of stool and serve as bulk laxatives such as Guar gum for improvement of bowel functioning and relieve constipation. The importance of dietary fibre is also anticipated as a protective factor in large bowel cancer by shortening the intestinal time, therefore, time for formation and action of carcinogens reduced that comes in touch with the gut wall.

Further, Yoga talks about the effect of food on the mind and vice versa. Those foods that improve vitality health and maintain good blood glucose levels are the ‘Satvik’ foods. Satvik diet is a diet based on foods mentioned in Yoga literature that contains sattva quality. In this system of dietary classification, foods that harm the mind or body are considered as Tamasik, while those that are stimulating and negative are considered Rajasik. Satvik diet is meant to include food and eating habit that is “pure, healthy, essential, natural, vital, containing energy that enhances longevity, clean and consciously managed”. Satvik diet is sometimes referred to as yogic diet in modern literature. In ancient and medieval era’s Yoga literature, the concept discussed is Mitahara, means “moderation in eating”. Satvik diet is a regimen that places emphasis on seasonal foods, fruits nuts seeds, oils, ripe vegetables, legumes, whole grains, and low calorie diets.

Yoga also advocates the effect of food on the mind and vice-versa and emphasis on the use of the Satvik food which is foods which increase the life, health, strength, purity, happiness and cheerfulness and good appetite are considered Satvik food. Satvik foods are considered as mild neither overcooked nor undercooked, such food lead to state of clam and alertness. Satvik foods not only provide nourishment for the body but also add vitality to the total system by bringing a perfect, harmonious balance of energy states in the food. The Yogic concept of food takes all the dimension of human existence into consideration. A ‘Balanced Diet’ according to Yoga, is the diet which restores balance at all levels. The Yogic diet believes in the concept of Mitahara. This postulates that the final effect of intake of diet is depends upon the quality of food (It should be satvik and more akin to the naturally form of it); quantity of food (half of the stomach should be filled with food, one forth with liquid and the rest one forth should be empty for the free flow of air); state of mind while taking food (during meals one should be calm and quiet; should relish the food, and not be engaged in any form of intense thinking activity). Srimadbhagwadgita describes the Yogic Diet as follows:

Yuktahara viharasya yuktacheshtasya karmasus, Yuktasupnavabodhasyas yogo bhavati dukhanah.  
Geeta verse 6:17

(He who is proper at food selection, conduct, sincere
in effort, and who is moderate in sleep and wakefulness, attains the state of *Yoga*, which destroys all the sorrows and miseries).

Table 1 — Details of different minerals and vitamins present in medicinal plants used in *Ayurveda*

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<tbody>
<tr>
<td>Moisture (%w/w)</td>
<td>10.0</td>
<td>11.5</td>
<td>9.9</td>
<td>7.6</td>
<td>11.6</td>
<td>9.4</td>
<td>8.4</td>
<td>9.2</td>
<td>11.7</td>
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<tr>
<td>Total ash (%w/w)</td>
<td>8.4</td>
<td>11.4</td>
<td>6.3</td>
<td>12.2</td>
<td>4.0</td>
<td>9.8</td>
<td>3.0</td>
<td>3.3</td>
<td>3.7</td>
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<tr>
<td>Fat (%w/w)</td>
<td>0.9</td>
<td>0.3</td>
<td>0.7</td>
<td>7.1</td>
<td>1.2</td>
<td>2.3</td>
<td>3.1</td>
<td>1.7</td>
<td>2.0</td>
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<tr>
<td>Crude fibre (%w/w)</td>
<td>18.1</td>
<td>6.5</td>
<td>64.0</td>
<td>14.6</td>
<td>3.5</td>
<td>22.4</td>
<td>2.1</td>
<td>1.4</td>
<td>2.9</td>
</tr>
<tr>
<td>Protein (%w/w)</td>
<td>4.9</td>
<td>14.8</td>
<td>19.0</td>
<td>12.2</td>
<td>5.0</td>
<td>12.5</td>
<td>2.6</td>
<td>4.1</td>
<td>4.6</td>
</tr>
<tr>
<td>Carbohydrate (%w/w)</td>
<td>57.7</td>
<td>55.3</td>
<td>--</td>
<td>46.4</td>
<td>74.8</td>
<td>47.0</td>
<td>80.8</td>
<td>80.3</td>
<td>75.1</td>
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<td>Calorific value kcal/100gm</td>
<td>258</td>
<td>284</td>
<td>82.6</td>
<td>298</td>
<td>330</td>
<td>245</td>
<td>361.5</td>
<td>353</td>
<td>336.8</td>
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<tr>
<td>Vit. C mg/100gm</td>
<td>12.8</td>
<td>23.4</td>
<td>15.2</td>
<td>34.4</td>
<td>9.6</td>
<td>112</td>
<td>7.9</td>
<td>9.6</td>
<td>7.9</td>
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<tr>
<td>Calcium mg/100gm</td>
<td>548</td>
<td>1227</td>
<td>580</td>
<td>346</td>
<td>246</td>
<td>1693</td>
<td>27.11</td>
<td>8.56</td>
<td>17.58</td>
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<tr>
<td>Iron mg/100gm</td>
<td>14.8</td>
<td>27.6</td>
<td>19.0</td>
<td>9.9</td>
<td>4.3</td>
<td>22.1</td>
<td>2.33</td>
<td>1.76</td>
<td>3.29</td>
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<tr>
<td>Zinc mg/100gm</td>
<td>2.1</td>
<td>3.9</td>
<td>3.7</td>
<td>2.0</td>
<td>BDL</td>
<td>43.2</td>
<td>0.96</td>
<td>0.58</td>
<td>0.46</td>
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<tr>
<td>Vit B1 mg/100gm</td>
<td>BDL</td>
<td>BDL</td>
<td>BDL</td>
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<td>BDL</td>
<td>BDL</td>
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<tr>
<td>Vit B2 mg/100gm</td>
<td>0.05</td>
<td>0.05</td>
<td>0.05</td>
<td>0.05</td>
<td>0.05</td>
<td>0.05</td>
<td>0.05</td>
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<tr>
<td>Vit B3, mg/100gm</td>
<td>0.05</td>
<td>0.05</td>
<td>0.05</td>
<td>0.05</td>
<td>0.05</td>
<td>0.05</td>
<td>0.27</td>
<td>0.33</td>
<td>0.30</td>
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In *yogic* practice, the practitioner should eat clean and proper food prepared from rice, barley flour, wheat, and different varieties of gram. The main five leafy vegetables which are recommended in the yogic diet are *balasaka, k alasaka, patola-patraka, vastuka* and *himalocika* [11]. *Yoga* also advocated about the controlled diet which is known as ‘*mitahara*’ that literally means “controlled diet”, such diet includes lubricant containing food and it is also recommended that the stomach should be half filled with food and quarter part of the stomach should be free for air and one quarter should be left empty, apart from that it is also recommended that the food should first offered to almighty. The importance of diet in general and *Mitahara* in particular can be well understood by the following *shloka* of “*Gherand samhita*” where it is very clearly mentioned that without a proper diet if someone performs *Yogic* practices it could lead to illness in stead of wellness.

मिताहारं विना यस्तु येगारस्मं तु कारयेत। नानारोगों भवेतस्य किजचयगों न सिध्यति।

[[घेरंडसंहिता १६।]]

*He who practices Yoga without moderation of diet, incurs various diseases, and obtains no success.*

Another interesting *shloka* about the *Rasa* in the *Gherand samhita* also elaborate about the food article...
to eat:

\[ \text{शुद्ध सुभं नौध्ये स्निष्ठं उदसर्यधितं।} \\
\text{भुज्यते सुरं प्रोत्या मिताहारमिम बिदु:} \]

||परंधसहिता २१||

Pure, sweet and cooling food should be eaten to fill half the stomach; eating thus sweet juice with pleasure, and leaving the other half of the stomach empty is called moderation in diet.

In the above shloka it is mentioned that the person should consume the food articles with Madhura rasa and snigdha guna. The results show that the plants Basella alba L. (Upodika) and Musa paradisiaca L. (Kadali) are having the same properties which are best suitable for the diet and could be consume by the Yogic practitioner. Use of vegetable proteins can restore the wear and tear of tissues as several asanas in yoga are non strenuous on physical plane. Further, the use of vegetables is also recommended for the practitioners of yoga as they also supply the requisite vitamins and minerals to the body. In a conceptual review on Yoga, bioenergetics and eating behaviors by Ramos-Jiménez et al., Pure and balance satvik diet was supposed to enhance the longevity, spirituality, health, energy, happiness and provide mental clarity and calmness. The Mahanarayan Upanishad (5000 BC) recommended the satvik diet for the saints and also endorse that it could promote the life expectancy of 100–150 yrs. Further, they also elaborated the components of satvik diet, viz. vegetables, fresh fruits, tubers, sprouted grains, nuts, curd, cow milk, and honey and recommended that all food in the diet should be fresh, juicy, nutritious, and tasty.

The importance of food in the vedic culture was also well understood, as there is a separate mantra known as “Bhojan Mantra” (Bhojan-food) originated from “Krishna Yajurved” which recommended before having the food which is as follows:

\[ \text{ॐ यल्लु नदयो: वर्ष्यसु परजया सुपिप्ला ओकिदयो:} \]
\[ \text{भक्तु:} || \]
\[ \text{अन्नवताम ओदलनताम मायमिशक्वताम एशाम राजा} \]
\[ \text{भूमयासन} || \]
\[ \text{ओदल् मुच्चुपते परमेश्वरा एष: यदोदन:} || \]
\[ \text{परममेवेनम श्रीयंगमयति} || \]


(May the rivers flow and the clouds give rain. May the plants yield good harvest. May I become the king of all those having plenty of food, boiled rice, curd and milk. Food is praiseworthy. This food is verily Brahma the creator. This will lead to the greatest prosperity in the form of health and wealth.)

Conclusion

The study revealed the nutritional profile of several plants mainly used in dietetics in Bengaluru and adjoining area. The results showed that all the plants studied have significant nutritional values in terms of crude fibre, calorific values, vitamins, protein and other important macro-elements. Moreover, it was also found during the study that Yoga advocates the role of ahara and in Yoga the use of satvik ahara consisting of vegetable and fruit diet is recommended. Some of the plant studied may be used in the Yogic diet as they possess good nutritional activities and also described and recommended in Ayurveda.

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