

*Short Communication*

## **Balance between nutrients and anti-nutrients in some plant food**

**Ali Aberoumand\***

Natural Resources College, Behbahan University, Behbahan, Iran.

\*Author to whom correspondence should be addressed, email: [aaberoomand@yahoo.com](mailto:aaberoomand@yahoo.com)

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### **Abstract**

Eight edible plants were analyzed in order to detect differences in nutritional quality, considering the balance between nutrients and anti-nutrient compounds present in each. The most important nutrients studied in this paper were: water, starch and free sugars, such as glucose, fructose and sucrose. The anti-nutrients measured included phytic acid and trypsin inhibitors. From this study, by considering the nutritional quality of each plant, it was possible to divide the eight edible plants into three groups, each being suitable for a different technological process.

**Keywords:** phytic acid, trypsin inhibitors, starch, nutrients, anti-nutrients

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### **Introduction**

Research has shown that the most important nutrients present in potatoes are carbohydrates, such as the starch and free sugars, organic acids, ascorbic acid and the antioxidant phenols, such as chlorogenic acid and its polymers. These molecules are involved in pathogen resistance in plants and the chlorogenic acid concentration represents about 90% of the total phenolic compounds in potatoes [1, 2, 3]. These parameters are important, not only for human nutrition but also in food processing. The concentration of these parameters could be influenced by different cultivars, farming system techniques and climatic conditions.

In order to evaluate the nutritional quality of different plants it is also important to include the concentrations of anti-nutrients, such as phytic acids and trypsin inhibitors. They appear to be unaffected by food processing, such as baking, cooking and frying [4, 5].

Heat-labile anti nutritional factors, such as trypsin inhibitors, are less important in human diets as cooking and processing are normally carried out before consumption. However, nutritional components are often degraded during prolonged processing methods [6].

Inositol hexakisphosphate (InsP<sub>6</sub>), commonly known as phytate, is a major component of plant storage organs such as seeds, roots and tubers, where it serves as a phosphate source for germination and growth. Due to its ability to chelate and precipitate minerals, phytate can decrease the bioavailability of critical nutrients such as zinc, iron, calcium and magnesium in food such as whole grains, nuts and legumes [7].

Nutritional quality is the *balance* between nutritional and anti-nutritional compounds. For this reason the concentration of water, starch, free carbohydrates (glucose, fructose and sucrose), protein and oil were selected for study. The anti-nutrients measured included phytic acid and trypsin inhibitors in eight edible plants widespread, in order to find if there are nutritional quality differences between them and, if possible, to choose appropriate cultivars for different food processes.

## Materials and Methods

### Collection of samples

Eight different types of fruit and vegetables were selected, based on common consumption in both Iran and India:

- *Alocacia indica* Sch. (Polly Dwarf )
- *Asparagus officinalis* DC
- *Chlorophytum comosum* Linn. (Spider Plant)
- *Cordia myxa* Roxb. (Large Sepesten)
- *Eulophia ochreatea* Lindl. (Wild Coco)
- *Momordica dioicia* Roxb. (Wild Balsam Apple)
- *Portulaca oleracia* Linn. (Moss Rose)
- *Solanum indicum* Linn.(Egg Plant)

The selected plants were either purchased or collected from various localities of Maharashtra (India) and Iran. Five wild edible plants were collected from Iran, namely, *Asparagus officinalis*, *Chlorophytum comosum*, *Cordia myxa*, *Portulaca oleracia* and *Solanum indicum* in October 2006 and April 2007. Efforts were made to collect these plants in flowering and fruiting condition for the correct botanical identification. Healthy and disease free edible plant portions of each variety of fruit and vegetable were collected to assess total phenolic contents.

### Sample preparation

Fresh fruit and vegetables were cleaned with water and external moisture wiped off with a dry cloth. The edible portion of the individual fruit was separated, dried in a hot air oven at 50°C for 1 h. The dried samples were then powdered in a blender for further study. Some of the plants were dried under shade so as to prevent the decomposition of chemical compounds present in them.

### Water

Water amounts were determined according to AOAC methods at 105°C [8].

### Starch

Total starch content was determined, using 100 mg dry samples, by a Diffchamb Enzy Plus Starch Kit (Diffchamn AB Sweden) [9].

**Carbohydrates**

One gm of fresh sample was extracted by 10 ml of acetonitrile/water (80:20 v/v), the sample was stirred and centrifuged at 3000 rpm for 10 min. Aliquots of this solution were filtered through a 0.45 µm Millex filter (Millipore) prior to injection into the HPLC.

A Beckman 342 HPLC model (Palo Alto, Ca USA), equipped with R.I. detector and an INERTSIL NH2 4 × 250 mm (GL Sciences Japan) column, was used. Fifty microlitres were injected into the column. An isocratic mode elution with a mobile phase of acetonitrile/water (80:20 v/v) at a flow rate of 0.5 ml/min was used.

**Determination of trypsin inhibitor**

According to AOCS 2005, using solutions containing sodium hydroxide, trypsin, acetic acid and BAPA, by method colorimetric in Absorption at 410 nm.

**Determination of phytic acid**

Phytate was determined by the standard methods of Early and DeTurk (1944) by method colorimetric in Absorption at 420 nm. Used solution containing 1.2% HCl and 10% Na<sub>2</sub>SO<sub>4</sub>, 0.6% HCl containing 5% Na<sub>2</sub>SO<sub>4</sub>, 3 ml of sulphuric and 3 ml of nitric acid.

**Results and Discussion**

Table 1 shows the values of water, glucose, fructose, sucrose and starch. All values found are in accordance with literature data [5] and each value is the mean of three determinations. In particular, the *Portulaca oleracia* plant showed the lowest values of water, glucose and fructose, the *Asparagus officinalis*, *Momordica dioicia* and *Eulophia ochreatea* plants showed low values of all free carbohydrates, and the *Asparagus officinalis*, *Momordica dioicia*, *Eulophia ochreatea*, *Portulaca oleracia* and *Solanum indicum* showed a low concentration of sucrose. The free sugars involved in the Maillard reaction form acrylamide. They are potential precursors for acrylamide formation and the cultivars with low sugar concentrations are more suitable than others for high temperature food processes. *Cordia myxa* had the highest value of sucrose and starch, probably due to a better storage process [10].

**Table 1. Water and sugars (g/100 g of dried product).**

Edible Plants	Water	Glucose	Fructose	Sucrose	Starch
<i>Alocacia indica</i>	6.19	2.1	8.06	2.09	60.41
<i>Asparagus officinalis</i>	6.48	1.53	6.86	ND	26.28
<i>Portulaca oleracia</i>	3.7	0.01	0.86	ND	39.8
<i>Momordica dioicia</i>	7.1	1.47	3.97	0.23	42.25
<i>Eulophia ochreatea</i>	5.33	1.48	1.62	0.46	55.75
<i>Solanum indicum</i>	5.01	3.19	5.21	0.59	29.5
<i>Cordia myxa</i>	6.21	12.75	9.38	29.09	5.86
<i>Chlorophytum comosum</i>	5.34	3.41	7.82	3.07	51.54

Table 2 shows the values of total phytic acid and trypsin inhibitor. The *Eulophia ochreata* and *Cordia myxa* plants had the lowest total phytic acid concentrations. Phytate can decrease the bioavailability of critical nutrients such as zinc, iron, calcium and magnesium in food, because of its ability to chelate and precipitate minerals. These two plants are thus more suitable, than others, for use in high temperature food processing. Other plants had different amounts of total phytic acid with highest values found in *Portulaca oleracia* and *Solanum indicum*. The same table also shows the amounts of trypsin inhibitor in each plant studied. The sum of both inhibitors, in all edible plants studied, was acceptable for human nutrition [11].

**Table 2. Total phytic acid compound and trypsin inhibitor of eight edible plants obtained from India and Iran.**

Edible plants	Phytic acid mg/100g	Trypsin Inhibitor (TIU/g)
<i>Alocacia indica</i>	312.4	7.9
<i>Asparagus officinalis</i>	340.8	0.8
<i>Portulaca oleracia</i>	823.6	16.9
<i>Momordica dioicia</i>	284.2	9.3
<i>Eulophia ochreata</i>	255.6	3.1
<i>Solanum indicum</i>	695.8	10.6
<i>Cordia myxa</i>	248.0	1.39
<i>Chlorophytum comosum</i>	468.8	4.7

Each value is the mean of three determinations.

## Conclusions

The nutrition parameters, such as water, starch and free sugars, in the edible plants studied, are in accordance with the literature data. The free sugar concentrations appear to be high in the *Solanum indicum*, *Cordia myxa* and *Chlorophytum comosum* plants. The starch concentration is low in the *Cordia myxa* plant.

The *Eulophia ochreata* and *Cordia myxa* plants present the lowest values of total phytic acid and *Cordia myxa* and *Asparagus officinalis* have very low concentrations of trypsin inhibitor.

Even if all plants have a safe concentration of total phytic acid and trypsin inhibitor, the gap between storage and the processing could imply a passage of time and the amount of these compounds could increase. In conclusion, the edible plants studied could be divided into three groups, each suitable for different technological processes [12].

**1st Group:** *Momordica dioicia*, *Eulophia ochreata* and *Portulaca oleracia*

These three plants are suitable for high temperature food processes, because they have very low free sugar concentrations; thereby reducing the possibility of Maillard reaction and then acrylamide formation [13].

**2nd Group:** *Alocacia indica*, *Eulophia ochreatea* and *Chlorophytum comosum*

These cultivars have a good quality and quantity of starch, but a low water content. However, they often have high values of trypsin inhibitor and, for this reason, it is better to employ them in low temperature processes such as minimally processed food and stir-fry food, because they have high concentrations of trypsin inhibitor that could increase during the storage period.

**3rd Group:** *Asparagus officinalis*, *Cordia myxa* and *Solanum indicum*

These cultivars should not be used in high temperature processes and should be cooked without the peel. It is suggested their best use would be for domestic purposes and home cooking.

**Acknowledgements**

The author would like to thank Prof. Mehdi Kadivar (Director, Department of Food Science, Isfahan Industrial University, Iran, for facilitating the analysis of plants.

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