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Assay of Nutrients and Anti-nutrients of Some Edible Plants of Iran and India

Ali Aberoumand[1] and S.S. Deokule[2]

[1]Prof. of Food Science, Natural Resources College,
Behbahan University, Behbahan, Iran
Corresponding Author E-mail: Aberoumand38@yahoo.com
[2]Department of Botany, University of Pune, Pune, India

Abstract

Eight edible plant foods have been 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, 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, we can divide the eight edible plants into three groups, each being suitable for a different technological processes.

Keywords: Edible plants; Nutrients; Anti-nutrients; Technological processes.

Introduction

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 the 90% of the total phenolic compounds in the potatoes (Bell, 1980), (Friedman, 2003); (Mondy and Gosselin, 1988). These parameters are important, not only for human nutrition but also in food processes. 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 (baking, cooking and frying).(Friedman, Roitman, and Kozukue, 2003) and (Souci- Fachmann-Kraut, 2000).

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 (Savage and Elliott, 1993).

Inositol hexakisphosphate ($InsP_6$), 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 foods such as whole grains, nuts and legumes (Thompson and Erdman,1982).

In our opinion, nutritional quality is the *balance* between nutritional and anti-nutritional compounds. For this reason we have studied, the concentration of: water, starch, free carbohydrates (glucose, fructose and sucrose), protein and oil. 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 fruits and vegetables (*Alocacia indica Sch (common name:*Polly Dwarf) *,Asparagus officinalis DC(common name: Asparagus,.* local name: Marchobeh) , *Chlorophytum comosum Linn.,(lacal name:*Sejafi, *common* name: spider plant) *Cordia Myxa Roxb*.(*local name:* Sepestan, *common name:* Large sebesten), *Eulophia Ochreata Lindl , common name:*Wild coco ., *Momordica* dioicia *Roxb.,* common name: Wild Balsam apple, *Portulaca oleracia Linn. (local name:* parpin, *common name:* Moss Rose) and *Solanum indicum Linn.*(local name: Angirak, common name: egg plant) were purchased from were collected from various localities of Maharashtra (India) and Iran. Five wild edible plants were collected from Iran viz *Asparagus officinalis, Chlorophytum comosum, Codia myxa, Portulaca oleracia and Solanum indicum* were collected from Iran in October 2006 and April 2007. Efforts made to collect these plants in flowering and fruiting conditions for the correct botanical identification. Healthy and disease free edible plant part/s selected each variety of fruit and vegetables were collected to assess total phenolic contents.

Samples preparation

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

Water

Water amount were determined measure according to AOAC methods at 105 °C (Nancy and Wendt Thiex, 2003).

Starch

Total starch content was determined, using 100 mg dry samples, by a Diffchamb Enzy Plus Starch kit (Diffchamn AB Sweden) (Beutler, 1984).

Carbohydrates

One gramme 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 microliters 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, used solutions contain Sodium hydroxide, Trypsin, Acetic acid and BAPA, by method colorimetric in Absorption at 410 nm.

Determination of Phytic acid

Phytate was determined by the methods of Early and DeTurk (1944) by method colorimetric in Absorption at 420 nm. Used solution contain a solution containing 1.2% HC1 and 10% Na2S04, 0.6% HCl containing 5% Na2S04, 3 ml of sulfuric and 3 ml of nitric acid.

Results and Discussion

In Table 1 shows the values of water, glucose, fructose, sucrose and starch. All values found are in accordance with literature data (Souci- Fachmann-Kraut, 2000). In particular, the *Portulaca oleracia* plant showed lowest values of water, glucose and fructose, the *Asparagus officinalis* and *Momordica dioicia* and *Eulophia ochreata* plants showed low values of all free carbohydrates, and the *Asparagus officinalis* and *Momordica dioicia* and *Eulophia ochreata*, *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 in high temperature food processes. The *Cordia myxa* has the highest value of sucrose and starch, probably due to a better storage process (Amrein et al., 2003).

In the 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 foods, because of its ability to chelate and precipitate minerals. these two plants are more suitable, than others, for use in high temperature food processes. Other plants had different amounts of Total Phytic acid with highest values in *Portulaca oleracia* and *Solanum indicum*. The same Table also shown the amounts of Trypsin inhibitor in each plant studied. The sum of both inhibitors, in all edible plants studied, was acceptable for human nutrition (Morgan and Coxon, 1987).

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

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

Each value is the mean of three determinations.

Table 2: Total Phytic acid compound and amount of Trypsin inhibitor of eight edible plants obtained from India and Iran.

Edible plants	Phytic acid mg/100g	Trypsin Inhibator (TIU/g)
Alocacia indica Sch	312.4	7.9
Asparagus officinalis DC	340.8	0.8
Portulaca oleracia Linn	823.6	16.9
Momordica dioicia Roxb	284.2	9.3
Eulophia ochreata Lindl	255.6	3.1
Solanum indicum Linn	695.8	10.6
Cordia myxa Roxb	248.0	1.39
Chlorophytum comosum Linn	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 sugars 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 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 (Quaderni di Filiera, 2003).

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 sugars concentrations; thereby reducing the possibility of Maillard reaction and then acrylamide formation (Mottram, 2002).

2nd Group: *Alocacia indica* and *Eulophia ochreata* and *Chlorophytum comosum*
These cultivars have a good quality of starch, but a low water content. However, they often have high values of Trypsin inhibitor; for these reasons, it is better to employ them in low temperature processes such as minimally processed foods and stir-fry foods, because they have high concentrations of Trypsin inhibitor that could increase during the storage period.

3rd Group: *Asparagus officinalis, Cordia myxa, Solanum indicum*
These cultivars should not be used in high temperature processes and should be cooked without the peel. We suggest their use for domestic purposes and home cooking.

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