2011 International Nuclear Atlantic Conference - INAC 2011
Belo Horizonte,MG, Brazil, October 24-28, 2011
ASSOCIAÇÃO BRASILEIRA DE ENERGIA NUCLEAR - ABEN
ISBN: **978-85-99141-04-5**

ANALYSIS OF KIWI FRUIT (*Actinidia deliciosa*) BY ENERGY DISPERSIVE X-RAY FLUORESCENCE SPECTRA

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ABSTRACT

The search for a healthy life has led consumers to eat fruits and vegetables in place of manufactured products, however, the demand for minimally processed products has evolved rapidly. The kiwi has at least eight nutrients beneficial to health: calcium, magnesium, manganese, phosphorus, iron, potassium, sodium and has also high vitamin C, which has wide acceptance in consumer markets. Energy dispersive spectroscopy X-ray (EDX) is the analytical technique used for elemental analysis or chemical characterization of a sample. It is a variant of fluorescence spectroscopy X-ray based on the sample through an investigation of interactions between electromagnetic radiation and matter, analyzing X-rays emitted by matter in response to being struck by charged particles. The aim of this study were to determine potassium, calcium, iron and bromine (K, Ca, Fe and Br, respectively) present in kiwifruit using the technique of fluorescence X-ray energy dispersive (EDXRF). Kiwifruit were peeled, washed and cut into slices and freeze-dried. After drying the sample was held digestion and subsequent reading of the same equipment in the X-ray fluorescence energy dispersive (EDXRF). The results indicated that the contents of potassium, calcium, iron and bromine are present in kiwifruit as expected when compared to Brazilian Table of Food Composition (TACO).

1. INTRODUCTION

The kiwi is a fruit originating in Asia rich in vitamin C, minerals and fiber. Fruit of a climbing plant belonging to the family of Actinidiaceas. The kiwi is typical of temperate

regions, characterized by being flat and oval. The rind has a light brown, covered with small hairs. Since the flesh is greenish, with several small seeds and black in the center. Being a low calorie fruit is much used in energy-restricted diets. About 90% of its weight consists of water [3].

Rich in vitamin C and with high nutritional value, kiwi (*Actinidia deliciosa*) has great acceptance in consumer markets. Like orange, kiwi is an option of vitamin C in diet consumption or substitute fresh citrus traditional [3].

The Kiwi has been recognized by the national American FDA (Food and Drug Administration) as an excellent source of vitamins: an average Kiwi has 138 mg of Vitamin C, and Vitamin E, protein, potassium, calcium, iron, magnesium, phosphorus and dietary fiber. The Kiwi also contains the amino acids glutamate, arginine, beta-carotene, phenolic compounds, flavonoids and chlorophyll reduces the risk of tumors [8].

Fluorescence spectroscopy X-ray technique is a qualitative and quantitative analysis of the chemical composition of samples. Consists of the exposure of solid or liquid samples to a radiation beam for excitation and detection of fluorescent radiation resulting from the interaction of radiation with the sample material [9].

The X-Ray Fluorescence Total Reflection (EDXRF) is a technique that uses XRF for the irradiation of the sample a very shallow angle of incidence in order to produce total reflection. The reflection occurs at the interface with the air sample and then placed with the reflective material as support for the sample. Due to the small thickness used for the samples there is little interaction of radiation with the sample, thus the scattering of the incident radiation is small, and what better detection limit [9]. The EDXRF technique is very versatile and can be applied in several samples, including solid state and liquid, without the need for comprehensive treatment for the preparation of these matrices, and also has the great advantage of being a non-destructive analytical method [5].

The TACO project (Brazilian Table of Food Composition), coordinated by the Center for Studies and Research in Food (NEPA) of UNICAMP and with funding from the Ministry of Health and Ministry of Social Development and Fight against Hunger (MDS). It is an initiative to generate data for a large number of nutrients in national and regional food obtained through representative sampling and analysis performed by laboratories with analytical skills demonstrated by interlaboratory studies, according to international criteria [6].

2. MATERIALS AND METHODS

2.1. Digestion of samples

We used the method described by [7], the samples were purchased in fruits stores in Piracicaba (State of São Paulo, Brazil). They were lyophilized and subjected to acid digestion where 500 mg of lyophilized sample was digested in an open system, using 6 ml HNO_3 p.a. (65% v/v). The temperature was gradually increased to 130ºC and then H_2O_2 p.a. (30% v/v) was added to sample until the solution becomes colorless, and the final volume was brought up to 10 ml with deionized water. The digestion procedure was carried out in triplicate.

2.2. Preparation of standards and samples for analysis by EDXRF

This procedure was based on work described previsously [1]. However, the sample volume pipetted on the Mylar film was 100 mL and the concentration of Ga was 10.25 mg/L. This element was used as internal standard. Analyses of samples and standards were performed in triplicate using an Energy Dispersive X-ray Fluorescence equipment.

3. RESULTS AND DISCUSSION

Among the various minerals present in the kiwi were selected four elements with atomic value less than 20, because the read range of the equipment used, therefore, as already mentioned elements have been randomly selected: potassium, calcium, iron and bromine. Table 1 contains the mean values of K, Ca, Fe and Br present in kiwi lyophilized.

Table 1. Values of K, Ca, Fe and Br present in kiwi

	Quantity (mg/100g kiwi)
K	240± 70
Ca	80 ± 30
Fe	2,12 ± 0,12
Br	2,1 ± 0,3

Table 2 contains the mean values of K, Ca, Fe and Br present in kiwi fruit to values according to the TACO [6] for comparison with the table 1.

Table 2. Values of K, Ca, Fe and Br present in kiwi according to TACO

	Quantity* (mg/100g kiwi)
K	269
Ca	24
Fe	0,3
Br	N*

N* = Not listed in the table
*TACO (2004)

According to Table 1 shows that potassium was the element given in larger quantities in dried kiwi, followed by calcium, iron and bromine.

As for the element potassium values were found near TACO (Table 2), because according to the kiwi analysis showed a mean 240 mg/100 g of kiwi while the reference features 269 mg/100 g. Considering the standard deviation of the potassium content in fresh and freeze-dried kiwifruit were close.

For the iron content was obtained from 2.12 mg/100 g of kiwi while the literature shows a level equivalent to 0.13 mg/100 g of kiwi. Therefore, the value found in the laboratory is much higher than expected according to TACO (Table 2). Faced with this result it is believed that contamination may have occurred for sample handling or contact with other surfaces.

The results obtained found that the amount of potassium is 10.8% less than the value presented in the reference table, as calcium and iron had 70% and 85.8%, higher than the reference values. With respect to the element bromine, the default table has not been submitted.

According to [4] the great difference in the amount of potassium and calcium was probably related to the characteristics of fruit and growing conditions. We can also say that the methodology used for detection of mineral elements was efficient when he compared with the results of certified standards by the IAEA (International Atomic Energy Agency). The high amount of potassium attracted our attention, because this element is an essential mineral for the human body, can be found in vegetables, citrus fruits and whole grains, which is responsible for standardization of water balance in the body, acts in mechanism of contraction and relaxation of muscles. Calcium is also important because it acts in the formation of bone and teeth, muscle contraction and nerve impulse transmission [2]. Therefore, these two elements found in greater quantity in the kiwi, are likely to further contribute to a healthy diet, rich in minerals.

3. CONCLUSIONS

The EDXRF technique was efficient to quantify the chemicals in question. From the results obtained we can conclude that the levels of potassium, calcium, iron and bromine are present in the kiwi-like TACO table used as standard. However, the potassium content was lower than the reference value, while the calcium and iron were higher. Therefore, the EDXRF technique was effective and can serve as a reference for use in the detection of minerals present in food.

ACKNOWLEDGMENTS

To FAPESP and CNPq for the support and assistance.

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