# A nutricional analysis of juices of ora-pro-nobis's leves and stalks


***Luciele Milani Zem***
***Henrique Soares Koehler***

Departamento de Fitotecnia e Fitossanitarismo. Universidade Federal do Paraná, Curitiba, PR, Brasil

E-mail: luzem@uol.com.br
koehler@ufpr.br

***Cristiane Vieira Helm***

Laboratório de Produtos Florestais Não Madeiráveis. Empresa Brasileira de Pesquisa Agropecuária.Embrapa Florestas, Colombo, PR, Brasil

E-mail: cristiane.helm@embrapa.br

***Katia Christina Zuffellato-Ribas***

Departamento de Botânica. Universidade Federal do Paraná, Curitiba, PR, Brasil

E-mail: kazu@ufpr.br



Recebido em: 13 abril 2018. Aceito em: 30 junho 2018.

DOI: http://dx.doi.org/10.21674/2448-0479.43.512-524



## Resumo

A elaboração de bebidas mistas permite obter novos sabores, texturas, melhorias de cor e associação entre os componentes nutricionais. Com isso, uma bebida formulada com suco de laranja e folhas de hortaliça não-convencional traz vantagens, principalmente para consumidores que desejam beneficiar-se de produtos naturais, ricos em nutrientes e sabor diferenciado. *Pereskia aculeata* é uma hortaliça não-convencional utilizada como complemento alimentar devido ao elevado teor de proteínas e ausência de toxicidade nas folhas. Assim, objetivou-se estudar a composição bromatológica de sucos de laranja lima e folhas e caules de *Pereskia aculeata*, visando identificar e quantificar os nutrientes e minerais presentes. Foram testados quatro tipos de sucos: suco natural de laranja lima (0%); acrescido de farinha de folhas secas (5%); acrescido de farinha de folhas+caules secos (5%); acrescido de folhas frescas (4 folhas), sendo realizadas as análises: umidade, cinzas, proteínas, fibras, lipídeos, em base úmida (g 100 $g^{-1}$). Concluiu-se que os sucos preparados com farinha de folhas secas de *Pereskia aculeata* apresentaram maior teor de proteínas; porém sucos preparados com farinha de folhas+caules secos mostraram melhor teor de fibras, enquanto o suco natural apresentou os menores valores calóricos totais. No entanto, tanto o suco de laranja lima com farinha de folhas secas e o com folhas frescas apresentaram resultados satisfatórios para os minerais fósforo, sódio, potássio, magnésio, cálcio, cobre, ferro e manganês. Desta forma, os sucos de laranja lima preparados com farinha de folhas secas e frescas de *Pereskia aculeata*, devido às boas qualidades nutricionais, são os mais indicados para o consumo.



**Palavras-chave:** Pereskia aculeata. Bebida. Análise bromatológica. Nutrição.

## Abstract

The elaboration of mixed drinks allows to obtain new flavors, textures, improvements of color and association between the nutritional components. Thus, a drink formulated with orange juice and leaves of unconventional vegetables can bring advantages, especially for those consumers who wish to benefit from natural products. *Pereskia aculeata* is an unconventional vegetable used as a food supplement because its high protein content and absence of toxicity in its leaves. The objective of this study is to study the bromatological contents of juices composed by the blend of lime orange, leaves and stem of *Pereskia aculeata*, in order to identify and quantify the nutrients and minerals present in them. Four types of lime orange juice were tested: natural lime orange juice (0%); with dry leaves flour (5%); leaf meal+dry stalks (5%); (100 g-1): moisture, ashes, proteins, fibers, lipids and carbohydrate, as well as in the dry matter. It was concluded that the juices prepared with dry leaves flour of Pereskia aculeata presented higher protein content; But juices prepared with dry leaf+stem flour have showed more fiber content, while the natural juice had the lowest caloric values total. However, both lime and orange juice, with dry leaves flour and fresh leaf preparation have shown satisfactory results for those minerals: phosphorus, sodium, potassium, magnesium, calcium, copper, iron and manganese. Thus, the lime orange juices prepared with dry leaves flour and fresh leaves of *Pereskia aculeata* are the most suitable for consumption because the good nutritional qualities.

**Keywords:** *Pereskia aculeate*. Beverage. Bromatological analysis. Nutrition.

## Introduction

The Brazilian fruit production is responsible for 10% of the world fruit production and its processing has become a strong part of the exploitation of the potential of its production, allowing to transform perishable products into storable products (DAMIANI *et al*., 2011).

The market segment of beverages is constantly on the rise in the consumption of non-alcoholic beverages, such as fruit juices in their most diverse forms of presentation. This preference is motivated by the consumer's choice for healthy foods that add functional benefits (MORZELE *et al*., 2009). Blends of processed juices or pulps are made to improve the characteristics of the individual components. Fruit blends are prominent in the commercialization of juices and industrialized nectars, that characterizes a new market and proposes products of high nutritional value (BRANCO *et al*., 2007).

Therefore, the preparation of blends or mixed drinks allows to obtain new flavors, textures, color improvements and association between the nutritional components (MORZELLE *et al*, 2011). The blend of flavors increases consumer interest (DAMIANI *et al*., 2011) and it results the fact that the blends formulation has an innovative appeal, providing a balance between nutritional and functional enrichment, as well, the sensorial aspect of the product (MOURA *et al*., 2014).

The use of fruit in the preparation of blends is essential, because they play an important role in human nutrition, because they contribution to the supply of calories, minerals, vitamins, fibers, water and other parts of plants, that are important sources of essential elements (GONDIM *et al*., 2005; SANTOS *et al*., 2010). Healthy food, rich in nutrients, is necessary to the human being and this can be achieved with parts of foods that are normally neglected. Therefore, it is important to use peels, stems and leaves, which may improve the nutritional quality of foods (GONDIM *et al*., 2005).

Stalk and leaves can be very nutritious as well as being good sources of fiber and lipids, as the example of broccoli, cabbage, spinach and broccoli leaves (ROCHA *et al*., 2008). These foods that are non-conventional to our menu such as *Pereskia aculeata* are known as unconventional food plants (UFP) and their consumption may be a strategy to maintain food diversification (KINUPP, 2007). UFP are among the food sources that develop in natural environments without the need for supplies, however, although available at low cost, they are still unknown and underutilized for a significant portion of the population (KINUPP, 2007; BRESSAN *et al*., 2011; LUIZA *et al*., 2013).

There is a diversity of fruit juice tastes, however, the most prominent is given to orange juice because its taste, wide acceptability and high availability in the market (BRANCO *et al*., 2007). A formulated drink with orange juice and leaves of UFP can bring benefits, mainly for the consumers who wish to use natural products, rich in nutrients and with distinguished flavor.

*Pereskia aculeata*, also called Ora-pro-nobis, is consumed by the rural and urban populations of Minas Gerais, contributing to food supplementation because it is rich in proteins, fibers, among other minerals, and also the family economy of the region (SOUZA *et al*., 2009). The absence of toxicity of its leaves and nutrient richness makes it important for the human food (TAKEITI *et al*., 2009). In addition to the cultural consumption habits of some regions such as Minas Gerais, their interest has been increasing in recent years by the food and pharmaceutical industry because the high content of proteins and mucilages found in this species (SOUZA *et al*., 2009). However, there are few reports of its importance on chemical constituents in preparations such as juices.

In fact of the great demand of the population for juices with higher nutritional quality and accessible to the majority of the population, this work aims to elaborate a blended juice, that raises the nutritional value of the product, therefore it aims to study the bromatological composition of orange juice prepared based on flour of leaves, dry stalks and fresh leaves of *Pereskia aculeata* in order to identify and quantify the nutrients and minerals present in them.

## Material and Methods

The vegetative material of *pereskia aculeata* was collected in Curitiba-PR, at coordinates 25 ° 38'29.28" south latitude and 49 ° 29'61.47" west longitude. According to the Köppen's classification, the weather of the region is of the type Cfb, it means the weather is characterized as humid temperate with average temperature of the month warmer above 10º C, with mild summers and winter with frequent frosts and tendency of concentration of rain in the months of summer, however, with no

defined dry season. Dried samples of the species were deposited in the herbarium of the Universidade Federal do Paraná (UFPR) and were classified as UPCB 75848.

Leaves and stems of *Pereskia aculeata* were collected for the purpose of preparing the flour to be used in food processing. The plant material was duly washed with a triple wash in distilled water and placed in an oven at 60 ° C for 24 hours. It was then crushed and stored in a freezer at -20 ° C for subsequent food production, except for fresh leaves. For the production of 100 g of flour, 1 kg of *Pereskia aculeata* leaves has been required.

For the preparation of the juices, four recipes were tested: lime orange juice without the addition of flour of *Pereskia aculeata* (natural juice - NJ); Lime orange juice + dry leaf flour (FDLJ); Lime orange juice + leaf flour + dry stems (DSLOJ), using 10 g of Pereskia aculeata flour in each mixture; Lime orange juice + 4 fresh leaves of Pereskia aculeata (FLOJ), (Table 1). In juice processing, oranges limes were obtained in commercial establishments in the city of Curitiba-PR, with the proportion of ingredients described in Table 1.

**Table 1-** Ingredients used in the blends formulations of *Pereskia aculeata*, Curitiba (PR), 2015.

| **Ingredients** | | **NJ[a]** | **FDLJ[b]** | **DSLOJ[c]** | **FLOJ[d]** |
|---|---|---|---|---|---|
| | | **Quantity** | | | |
| Lime Orange | mL | 200 | 190 | 190 | 190 |
| *Pereskia aculeata* | g | - | 10 | 10 | 4 leaves |

NJ – Natural Juice, Flour; FDLJ- Flour and dry leave juice; DSLOJ – Dry stalk and leaves' Orange juice. FLOJ- Fresh leaves Orange juice.

The bromatological analyzes were carried out in the Laboratory of Non-Timber Forest Products of EMBRAPA (Brazilian Agricultural Research Corporation), located in Colombo-PR, and performed according to the official methodologies of the Adolfo Lutz Institute (BRASIL, 2008) and the data expressed as percentage on wet basis of water's food) and on a dry basis (determined by the greenhouse method to a constant weight). The analyzes were performed in triplicate, so that each data corresponded to the average of three replicates.

For the results of nutritional composition, except for total dietary fiber and total carbohydrates, the others (moisture, ashes, lipids and proteins) were made in triplicate according to the official methodology of the Instituto Adolfo Lutz (INSTITUTO ADOLFO LUTZ, 2008). The humidity of the samples was determined in about 5 g of sample which remained for 12 hours in an oven with a temperature of 105 ° C. The percentage value of moisture was obtained by multiplying the mass loss (g) of the sample by 100 and dividing that result by the mass (g) of the sample. Ashes, representing the total minerals, were determined by calcining approximately 2 g of sample in the plate at 550 ° C for three hours. The ash percentage was obtained by multiplying the mass (g) of ashes of the sample by 100 and dividing that result by the mass (g) of the sample.

The lipids were determined in 1.5 g of the sample using ethyl ether as the extracting solvent for six hours in soxhlet extractor. The ethereal extract obtained was placed in an oven set at 70 ° C for one hour to remove residue from the solvent, followed by cooling in a dry and subsequently weighed environment. The lipid content was calculated by multiplying the lipid mass by 100 and this result divided by the mass (g) of the sample. Total proteins were obtained in 0.5 g of sample by the micro

Kjeldahl method, which quantifies the total nitrogen content of the sample. The percentage of proteins was calculated by multiplying the percentage of total nitrogen through the conversion factor 6.25.

The dietary fiber was determined by the enzymatic gravimetric method with 1 g, consisting of hydrolyzing the starch to obtain the protein through the use of protease, heat stable alpha-amylase and amyloglucosidase (glucoamylase) enzymes.

The total caloric value, in kcal, was determined considering the conversion factor 4.0 for proteins and carbohydrates and 9.0 for lipids. Macronutrient minerals and micronutrients were determined by the Laboratory of Soil Chemistry and Fertility, Federal University of Paraná, in Curitiba-PR.

## Results and Discussion

The dry chemical composition of the juice showed that the variables ash and protein showed a significant difference at 5% and 1% probability (Table 2). The blend of lime orange juice with *Pereskia aculeata* can be considered a new product, there's no reference of comparison of values for the performed analyzes.

**Table 2 -** Percentage of ashes, lipids, fibers, total carbohydrates (TC) and total caloric value (TCV) of the blends of Pereskia aculeata, Curitiba (PR), 2015.

| | Dry Basis | | | | |
|---|---|---|---|---|---|
| | **NJ[a]** | **FDLJ[b]** | **DSLOJ[c]** | **FLOJ[d]** | **Variation Coefficient (%)** |
| **Ashes(%)** | 1,53 ab | 1,72 a | 0,86 bc | 0,76 c | 22,34 |
| **Lipids (%)** | 0,03 a | 0,11 a | 0,06 a | 0,09 a | 60,47 |
| **Proteins (%)** | 0,50 b | 0,66 a | 0,63 ab | 0,53 ab | 9,69 |
| **Fibers (%)** | 0,40 a | 0,29 a | 0,86 a | 0,73 a | 34,46 |
| **TC (%)** | 4,44 | 4,34 | 6,60 | 8,44 | |
| **TCV (kcal 100 g$^{-1}$)** | 20,03 | 20,99 | 29,46 | 36,69 | |

Coefficients followed by the same letter in the line do not differ statistically at the 5% level of significance. Orange lime juice (NJ); orange juice with dry leaf flour (FDLJ); Lime orange juice with dry leaf + stem flour (DSLOJ); Lime orange juice with fresh leaves (FLOJ).

The determination of moisture is one of the most important measure used in food analysis, since it is related to its stability, quality and composition (IZIDORO *et al*., 2008). Besides, it can influence the characteristics of the sample, the preservation of the product and its high content allows the activity of microorganisms and enzymes to modify its sensorial characteristics (MORGANO *et al*., 2008).

The moisture content of the orange lime juice was higher than other juices with 93.07%, not differing of lime orange juice with dry leaves flour (92.85%). The lime orange juice with dry leaf + stem flour presented 90.96% humidity and fresh leaves 89.43%. Analyzing the data, it is noticed that the water content has reduced with the addition of *Pereskia aculeata*.

Theoretically, the moisture content of lime orange juice with fresh leaves should be higher than the others because the presence of water in the leaves, but it is noted that it was lower. This should be related to the amount of leaves used in each juice preparation, because the lime orange

juice with fresh leaves, only four leaves were used. For the preparation of the lime orange juice with dry leaves flour was necessary, almost, 100 leaves for the preparation of the flour.

The fact that the natural lime orange juice has a higher moisture content may be related to the extra 10 ml of lime orange used in the preparation of the juice. Is importante to report that the moisture content of raw lime orange is 87.00% (NÚCLEO DE ESTUDOS E PESQUISAS EM ALIMENTAÇÃO-UNICAMP, 2011).

The reduction of moisture is important to the conservation of a product and it occurs because the removal of water, then reducing the rates of chemical reactions and inhibiting microbial growth (PALACIN *et al*., 2005).

According to the Brazilian food composition table (NÚCLEO DE ESTUDOS E PESQUISAS EM ALIMENTAÇÃO-UNICAMP, 2011), orange juice has a water content of 89.70%, a similar value found in the juices of the present study.

Ashes can represent as much as 10% of the reduced dry extract in the juice (NOGUEIRA *et al*., 2007; STORCK *et al*., 2013). According to the Brazilian food composition table (NÚCLEO DE ESTUDOS E PESQUISAS EM ALIMENTAÇÃO -UNICAMP, 2011), lime orange juice contains 0.30% of ash, lower than the analyzed juices. It shows that the juices of the present study may possess a greater amount of minerals in their composition.

The percentage of ash ranged from 0.76% (orange juice with fresh leaves) to 1.72% (lime orange juice with dry leaves flour) and there was no significant difference between lime orange juice and dry leaves flour with the natural juice, 1.53% (Table 2). The fact that the lime orange juice with fresh leaves had the lowest percentage of ash may have been influenced by the amount of leaves used in the preparation of the same. And the fact that the percentage of lime orange juice with dry leaves flour was higher than dried leaves + stem flour should be related to the amount of ash present in each flour which was approximately 20.13% and 11.24%, respectively (ZEM, unpublished results.).

Lipids are important to the growth, development and maintenance of health and their content varies according to the type of each food, with fruits and leafy vegetables being among the foods with the lowest levels (0.1 - 1, 2% of the fresh composition) (AUED-PIMENTEL; ZENEBON, 2009).

The lipid content of the analyzed juices varied from 0.03% (natural orange juice) to 0.11% (lime orange juice with dry leaf flour). These results show that *Pereskia aculeata* can be used in the preparation of orange juice without a large increase in lipid content (Table 2). This low lipid content is a positive aspect, then these foods can be used in lipid-restricted and low-calorie diets (ROCHA *et al*., 2008). However, only lime orange juice with dry leaf flour and lime orange juice with fresh leaves is found in the Brazilian composition table for lime orange juice, which is 0.10% (NÚCLEO DE ESTUDOS E PESQUISAS EM ALIMENTAÇÃO-UNICAMP, 2011).

On proteins, they are known to be important for human growth and development (STORCK et al., 2013). Moreover, there is evidence that diets with a higher proportion of proteins and a lower proportion of carbohydrates promote greater weight loss, greater reduction of body fat and less loss of lean mass (LAYMAN *et al*., 2005).

The analyzed juices presented satisfactory results regarding proteins when compared to the Brazilian composition table for lime orange juice, which is 0.70 g (NÚCLEO DE ESTUDOS E

PESQUISAS EM ALIMENTAÇÃO-UNICAMP, 2011). The lime orange juice with dry leaves flour was numerically the highest with 0.66%, but it did not differ from the lime orange juice with dry leaves flour with the natural juice, 1.53% (Table 2). The fact that the lime orange juice with fresh leaves had the lowest percentage of ash may have been influenced by the amount of leaves used in the preparation of the same. The result of the percentage of lime orange juice with dry leaves flour was higher than that of dried leaves + stem flour should be related to the amount of ash present in each meal which was approximately 20.13% and 11.24%, respectively (ZEM, unpublished results).

Lipids are important in the growth, development and maintenance of health and their content varies according to the type of each food, with fruits and leafy vegetables being among the foods with the lowest levels (0.1 - 1, 2% of the fresh composition) (AUED-PIMENTEL; ZENEBON, 2009).

The lipid content of the analyzed juices varied from 0.03% (natural orange juice) to 0.11% (lime orange juice with dry leaf flour). These results show that *Pereskia aculeata* can be used in the preparation of orange juice without a large increase in lipid content (Table 2). This low lipid content is a positive aspect, since these foods can be used in lipid-restricted and low-calorie diets (ROCHA *et al*., 2008). However, only lime orange juice with dry leaf flour and lime orange juice with fresh leaves is found in the Brazilian composition table for lime orange juice, which is 0.10% (NÚCLEO DE ESTUDOS E PESQUISAS EM ALIMENTAÇÃO-UNICAMP, 2011).

On proteins, they are known to be important for human growth and development (STORCK *et al*., 2013). Moreover, there is evidence that diets with a higher proportion of proteins and a lower proportion of carbohydrates promote greater weight loss, greater reduction of body fat and less loss of lean mass (LAYMAN *et al*., 2005).

The analyzed juices presented satisfactory results for proteins, when compared to the Brazilian composition table for lime orange juice, which is 0.70 g (NÚCLEO DE ESTUDOS E PESQUISAS EM ALIMENTAÇÃO-UNICAMP, 2011). Lime orange juice with dry leaves flour was numerically the highest with 0.66%, but it did not differ from lime orange juice with dry leaf + stem flour (0.63%) and lime orange juice With fresh leaves (0.53%) (Table 2).

It can be seen because thoses species are rich in proteins and there was an increase of 32%, 26% and 6% in the juices prepared with dry leaves flour, with dry leaf + stem flour and with fresh leaves, respectively, in Relation to the natural orange lime juice. This fact shows the importance of the consumption of juices prepared with *Pereskia aculeata*, because some population groups still have a diet with limited access to animal proteins, and can contribute to prevent or treat these nutritional deficiencies. (ALMEIDA *et al*., 2014).

On the fibers, the results showed that there was no significant difference in the percentage of fibers found for the liquefied analyzed orange juice, which ranged from 0.86% (lime orange juice with dry leaf + dry flour) to 0 , 29% (lime orange juice with dry leaf flour) (Table 2). According to the Brazilian table of food composition, the ideal is that lime orange juice had a content of 0.40% of fibers (NÚCLEO DE ESTUDOS E PESQUISAS EM ALIMENTAÇÃO-UNICAMP, 2011), but the only analyzed juice that was lower than the recommended juice was orange lime with dried leaf flour. This can be related to the grain size, since with the reduction of grain size, there is a significant reduction in the fiber content (STORCK *et al*., 2015).

Storck et al. (2013) studied the centesimal composition of the juice of papaya with lemon peel obtained a content of 0.30% of fibers, similar result to lime orange juice with dry leaves flour (0.29%). This shows that the addition of flours to food products can add interesting functional properties to human health, enriching the products (STORCK *et al*., 2015).

It is important to remember that dietary fiber has an impact on intestinal transit velocity, on the colon pH, and on the production of by-products with important physiological function (BERNAUD; RODRIGUES, 2013). Normally, its low consumption is related to the occurrence of intestinal constipation and weight gain (VITOLO *et al*., 2007).

A food can be considered rich in fiber if it presents a minimum of 3% for liquids (AGÊNCIA NACIONAL DE VIGILÂNCIA SANITÁRIA, 2005). Therefore, all natural orange lime juice with *Pereskia aculeata* can not be considered a good source of fiber. However, the lime orange juice with dry leaf + stem flour and the fresh leaves of *Pereskia aculeata* added a higher nutritional value of fiber when compared to natural juice (0.40%). Foods rich in fiber could replace the energy (calories) of those not eaten foods (BERNARD; RODRIGUES, 2013).

As well as being an important constituent in the prevention and treatment of several chronic diseases (ALMEIDA *et al*., 2014).

Regarding the total caloric value, it was observed that the juices presented total caloric values between 20.03 kcal·100 $g^{-1}$ and 36.69 kcal·100 $g^{-1}$. It means that in a normal 2000 Kcal diet, over 100 mL of the juices would supply between 1.00 kcal and 1.80 kcal·100 $g^{-1}$ of the daily recommendation.

The consumption of foods with low caloric value is better for human health and for the control of obesity (ALMEIDA *et al*., 2014). However, the entire context of the food must be analyzed void of a food with low total caloric value is the most suitable for consumption because its nutritional value is lower. Thus, natural orange juice despite the lowest total caloric value (20.03 kcal·100 $g^{-1}$), when compared to the other juices presented lower nutritional values.

One of the causes of obesity is the increase in the consumption of soft drinks when compared to the consumption of juices. It is worth mentioning that soft drinks provide empty calories, that is, without any type of nutrient and without nutritional value (SWEETYMAN *et al*., 2008; ESTIMA *et al*., 2011). Because of this, there should be an incentive for the consumption of blends of *Pereskia aculeata*.

As result for carbohydrate content, the juice presented values between 4.34% (lime orange juice and dry leaves flour) at 8.44% (lime orange juice with fresh leaves) (Table 2). The minimum amount of carbohydrate required is 130 g a day for men and women over the age of 19 years (AGÊNCIA NACIONAL DE VIGILÂNCIA SANITÁRIA, 2005), with the consumption of 100 ml of lime orange juice with dry leaf flour and the preparation with fresh leaves would provide 3.33% and 6.49%, respectively, of the daily recommendations of an adult.

Minerals are important for the good health of the human body, being essential to its proper functioning; However, their daily amount of consumption is low (GONDIM *et al*., 2005).

The values found for lime orange juice in the Brazilian food composition table were 16 mg for phosphorus, 129 mg for potassium, 11 mg for magnesium, 8 mg for calcium, 0.02 mg for Cu, 0.02 mg for Manganese, 0.00 mg for zinc and for sodium and iron, values below the limit of quantification were

found (NÚCLEO DE ESTUDOS E PESQUISAS EM ALIMENTAÇÃO-UNICAMP, 2011). When analyzing the blends of *Pereskia aculeata*, they have showed results similar to those of the Brazilian food composition table (Table 3).

**Table 3 -** Percentage of minerals phosphorus (P), sodium (Na), potassium (K), magnesium (Mg), calcium (Ca), copper (Cu), iron (Fe), manganese (Mn) and zinc (Zn) , Blends of Pereskia aculeata, Curitiba (PR), 2015.

| Minerals | | NJ[a] | FDLJ[b] | DSLOJ[c] | FLOJ[d] | Variation Coefficient (%) |
|---|---|---|---|---|---|---|
| **P** | g $kg^{-1}$ | 0,66 b | 0,78 ab | 0,85 a | 0,88 a | 8,74 |
| **Na** | | 0,01 a | 0,01 a | 0,03 a | 0,03 a | 73,18 |
| **K** | | 3,20 b | 4,13 a | 3,91 a | 3,80 a | 4,80 |
| **Mg** | | 0,06 a | 0,14 a | 0,13 a | 0,13 a | 24,81 |
| **Ca** | | 1,38 a | 0,56 b | 0,90 b | 0,85 b | 19,05 |
| **Cu** | mg $kg^{-1}$ | 3,14 a | 3,25 a | 3,73 a | 3,93 a | 16,61 |
| **Fe** | | 16,27 a | 20,73 a | 13,07 a | 15,05 a | 42,85 |
| **Mn** | | 3,83 b | 4,81 ab | 4,17 b | 5,85 a | 10,74 |
| **Zn** | | 0,30 b | 0,21 b | 0,81 a | 1,01 a | 30,28 |

Coefficient followed by the same letter in the column (lower case) and in the line (upper case) do not differ statistically at the 5% level of significance by the Tukey Test. Orange lime juice (NJ); orange juice with dry leaf flour (FDLJ); Lime orange juice with dry leaf + stem flour (DSLOJ); Lime orange juice with fresh leaves (FLOJ).

The analysis of macro and micronutrients contents in the blends indicates that, in general, the best mineral contents were found in lime orange juice with fresh leaves of *Pereskia aculeata*. However, for all nutrients except manganese and zinc, it did not differ from lime orange juice with dry leaf flour and leaf meal + dry stalks. The orange lime juice presented numerically lower results than the other juices analyzed except for the calcium that showed better results with 1.38 g·$kg^{-1}$.

When analyzing the phosphorus, fresh orange juice with fresh leaves of *Pereskia aculeata*, with dry leaf flour and dry leaf + stem flours presented the highest levels with 0.88 g·$kg^{-1}$, 0.78 g·$kg^{-1}$ and 0.85 g·$kg^{-1}$ respectively. The lime orange juice presented the lowest content with 0.66 g·$kg^{-1}$, not differing only from that prepared with dry leaves flour. It is worth mentioning that the concentration of phosphorus in the juice may be related to the degree of demand and the absorption capacity of the plant root system (NOGUEIRA *et al*., 2007).

In relation to the sodium, there was no significant difference for the analyzed juices showing a variation of 0.01 g·$kg^{-1}$ (lime orange juice and lime orange juice with dry leaf flour) at 0.03 g·$kg^{-1}$ (Lime orange juice with leaf flour + dried stem and lime orange juice with fresh leaves). (SATO *et al*., 2009). In the present study, the use of sodium as a source of sodium in the diet was associated with higher salt intake to the cronical deseases.

Potassium is associated with reduced cardiovascular events, so its high intake is important for lowering blood pressure and mortality by stroke and heart disease (O'DONNEL *et al*., 2011). Because of this, the consumption of foods with high potassium content is of importance; therefore, juices prepared with *Pereskia aculeata* would be the most indicated because they presented higher potassium contents (4.13 g·$kg^{-1}$ for juice with dry leaves flour, 3.91 g·$kg^{-1}$ for juice with Leaves + stem; 3.80 g·$kg^{-1}$ for fresh leaf juice) when compared to natural orange juice (3.20 g·$kg^{-1}$) (Table 3).

However, magnesium is an essential element that plays a fundamental role in enzymatic activities, acting on the stability of the neuromuscular and cardiovascular membrane and as a physiological regulator of the hormonal and immunological function (WILBORN *et al*., 2004; BUENO,

2008). Therefore, the consumption of *Pereskia aculeata* blends becomes important because its higher magnesium content when compared to natural lime orange juice (0.06 g·kg$^{-1}$). Lime orange juice with dry leaf meal was the one with the highest magnesium content with 0.14 g·kg$^{-1}$, representing about 54% of the daily recommendation that is 260 mg for an adult (AGÊNCIA NACIONAL DE VIGILÂNCIA SANITÁRIA, 2005). However, this juice did not differ from lime orange juice with dry leaf + stem flour (0.13 g·kg$^{-1}$) and that prepared with fresh leaves (0.13 g·kg$^{-1}$).

As result for calcium, it is known to be an important mineral whose main sources found in foods, such as milk and its derivatives, have not been consumed in the recommended amounts per day (ALMEIDA *et al*., 2014). The calcium content was significantly higher for the natural orange juice (1.38 g·kg$^{-1}$), which is higher than that presented by the Brazilian table of food composition, which is 8 mg (NÚCLEO DE ESTUDOS E PESQUISAS EM ALIMENTAÇÃO -UNICAMP, 2011). In order that, the consumption of 100 mL of this juice would provide more calcium than the daily recommendations of an adult, 1000 mg·day$^{-1}$ (AGÊNCIA NACIONAL DE VIGILÂNCIA SANITÁRIA, 2005). It is worth remembering that the administration of calcium supplementation may influence its bioavailability, as long as the efficacy of calcium absorption decreases with increasing intake.

Because of this it would be more interesting to consume lime orange juice with dried leaves flour of *Pereskia aculeata*, as it supplies around 56% of the daily calcium recommendation. Lime orange juice with leaf + stem flour and fresh leaves as well as orange lime juice also have high amounts of calcium, with 0.90 mg·kg $^{-1}$ and 0.85 mg·kg$^{-1}$, respectively. It is observed that doses above 500 mg per day may decrease the efficiency of calcium absorption and is not very interesting (WEAVER; HEANEY, 2006)

In relation to the copper, this is an essential micronutrient and important constituent of blood and its lack in humans is very rare (MACÊDO *et al*., 2010). The orange juice analyzed has an excellent copper content, as long as its daily recommendation is 900 µg (AGÊNCIA NACIONAL DE VIGILÂNCIA SANITÁRIA, 2005) and they ranged from 3.93 mg·kg$^{-1}$ (orange juice with fresh leaf flour) to 3,14 mg·kg $^{-1}$ (natural orange juice) (Table 3).

As result for iron, its deficiency develops in several stages, and this occurs because its inadequate consumption in the diets fed (SUNS, 2007; SATO *et al*., 2009). The iron levels of the analyzed juices did not present significant differences among them, however, the orange juice with dried leaves flour of *Pereskia aculeata* was numerically superior to the others, with 20.73 mg·kg$^{-1}$ (Table 3).

Manganese is an essential element and its diet is the main source for people who are not occupationally exposed, playing an important role in the process of bone and tissue formation, reproductive functions and metabolism of carbohydrates and lipids, but it is emphasized that, in excess, becomes a neurotoxic element (MOREIRA; PIVETTA, 1996; NEVES *et al*., 2009). Among the analyzed juices, lime orange juice with fresh leaves presented the highest Mn content with 5.85 mg kg-1, but it did not differ of that prepared with dry leaves flour (4.81 mg·kg$^{-1}$).

As result for zinc, it is a mineral that is distributed in the human body in small concentrations, and its deficiency is related to severe pathological conditions, with its daily recommendation of 8 mg for women and 11 mg for men (HAMBIDGE *et al*., 2008). Therefore, according to the results of the

work, all analyzed juices can be considered good sources of zinc. The highest levels were found in lime orange juice with fresh leaves (1.01 $mg \cdot kg^{-1}$) and in the dry leaf + stem flour (0.81 $mg \cdot kg^{-1}$), with no significant difference between them (Table 3).

## Conclusion

Under the conditions which the present experiment was carried out, it was possible to conclude that the use of flour of dried leaves and leaves + dried stems, as well as fresh leaves of *Pereskia aculeata*, increased the nutritional value of the product. The lime orange juice prepared with *Pereskia aculeata* has raised the nutritional value of the product.

Juices prepared with *Pereskia aculeata* had better protein contents and lime orange juice with leaf meal + dry stalks had a higher fiber content while orange lime juice showed the lowest total caloric value. The lime orange juices prepared with dry leaf flour and fresh leaves of *Pereskia aculeata* presented more nutritional quality for minerals, phosphorus, sodium, potassium, magnesium, calcium, copper, iron and manganese.

## References

ALMEIDA, M. E. F. et al. Caracterização química das hortaliças não-convencionais conhecidas como ora-pro-nobis. **Bioscience Jounal**, v.30, n.1, p.431-439, 2014.

AGÊNCIA NACIONAL DE VIGILÂNCIA SANITÁRIA - ANVISA. Portaria nº 27 - Informação Nutricional complementar. **Agência Nacional de Vigilância Sanitária.** Brasília, DF. 2005.

ASSUNÇÃO, M. C. F.; SANTOS, I. S. Efeito da fortificação de alimentos com ferro sobre anemia em crianças: um estudo de revisão. **Caderno Saúde Pública**, v.23, n.2, p.269-281, 2007.

AUED-PIMENTEL, S.; ZENEBON, O. Lipídeos totais e ácidos graxos na informação nutricional do rótulo dos alimentos embalados: aspectos sobre legislação e quantificação. **Revista do Instituto Adolfo Lutz**, v.68, n.2, p.167-181, 2009.

BERNAUD, F. S. R.; RODRIGUES, T. C. Fibra alimentar – Ingestão adequada e efeitos sobre a saúde do metabolismo. **Arquivos Brasileiros de Endocrinologia & Metabologia**, v.57, n.6, p.397-405, 2013.

BRANCO, I. G. et al. Avaliação sensorial e estabilidade físico-química de um *blend* de laranja e cenoura. **Ciência e tecnologia de Alimentos**, v.27, n.1, p.7-12, 2007.

DAMIANI, C. et al. Néctar misto de cajá-manga com hortelã: caracterização química, microbiológica e sensorial. **Revista Brasileira de Produtos Agroindustriais**, v.13, n.3, p.301-309, 2011.

ESTIMA, C.C. P. et al. Consumo de bebidas e refrigerantes por adolescentes de uma escola pública. **Revista Paulista de Pediatria**, v. 29, n. 1, p. 41-45, 2011.

GONDIM, J. A. M. et al. Composição centesimal e de minerais em cascas de frutas. **Ciência e Tecnologia de Alimentos**, v.25, n.4, p.825-827, 2005.

HAMBIDGE, M. K.; MILLER, L. V.; WESTCOTT, J. E. Dietary Reference Intakes for Zinc May Require Adjustment for Phytate IntakeBased upon Model Predictions. **Journal of Nutrition**, v.138, p.2363-2366, 2008.

HEANEY, R. P. Calcium intake and disease prevention. **Arquivos Brasileiros de Endocrinologia e Metabologia**, v. 50, p. 685-693, 2006.

INSTITUTO ADOLFO LUTZ- IAL. Procedimentos e determinações gerais. In: LUTZ, I. A. **Métodos Físico-químicos para análise de alimentos.** 4ª edição/1ª edição digital. ed. São Paulo: Instituto Adolfo Lutz, v.1, 2008. Cap.4, p.1020.

IZIDORO, D. R. et al. Avalição físico-química, colorimétrica e aceitação sensorial de emulsão estabilizada com polpa de banana verde. **Revista do Instituto Adolfo Lutz**, v.67, n.3, p.167-176, 2008.

LAYMAN, D. K. et al. Dietary protein and exercise have additive effects on body composition during weight loss in adult women. **Journal Nutrition**, v. 135, n. 8, p. 1903-1910, 2005.

LEMOS, D. M. et al. Avaliação físico-química de um *blend* de laranja tangor 'Ortanique' e beterraba. **Revista verde**, v.7, n.3, p.207-211, 2013.

LUCIO, I. B.; FREITAS, R. J. S.; WASZCZYNSKYJ, N. Composição físico-química e aceitação sensorial da inflorescência de gengibre orgânico (*Zingiber officinale* Roscoe). **Ciência e Tecnologia de Alimentos**, v.30, n.3, p.652-656, 2010.

MACÊDO, E. M. C. et al. Efeitos da deficiência de cobre, zinco e magnésio sobre o sistema imune de crianças com desnutrição grave. **Revista Paulista de Pediatria**, v. v. 28, n. 3, p. 329-336, 2010.

MOREIRA, F. R.; PIVETTA, F. Manganese Determination in Air, Blood and Urine, using $Mg(NO_3)_2$ as modifier and "In Situ" decontamination by graphite furnace atomic absorption spectrometry. **Atomic Spectroscopy**, v. 19, n. 4, p. 24-30, 1996.

MORZELLE, M. V. et al. Desenvolvimento e avaliação sensorial de néctar misto de maracujá (*Passiflora edulis* Sims) e araticum (*Annona crassiflora*). **Revista Brasileira de Produtos Agroindustriais**, v.13, n.2, p.131-135, 2011.

MOURA, R. L.; FIGUEIRÊDO, R. M. F.; QUEIROZ, A. J. M. Processamento e caracterização físico-química de néctares goiaba-tomate. **Revista Verde de Agroecologia e Desenvolvimento Sustentável**, v.9, n.3, p.69-75, 2014.

NÚCLEO DE ESTUDOS E PESQUISAS EM ALIMENTAÇÃO - NEPA-UNICAMP. **Tabela brasileira de composição de alimentos.** 4 ed. Campinas: NEPA-UNICAMP, 2011. 161 p.

NEVES, E. B. et al. Avaliação da exposição a metais numa oficina de recuperação de armamento de uma organização militar. **Ciência e Saúde Coletiva**, v. 14, n. 6, 2009.

NOGUEIRA, A. et al. Influência do processamento no teor de minerais em sucos de maçãs. **Ciência e Tecnologia de Alimentos**, v.27, n.2, p.259-264, 2007.

O' DONNELL, M. J. et al. Urinary sodium and potassium excretion and risk of cardiovascular events. **Jama**, v. 306, n. 20, p. 2229-2238, 2011.

PALACIN, J. J. F. et al. Determinações das curvas de secagem de milho nas espigas (*Zea mays* L.). **Engenharia na agricultura**, v. 13, n. 4, p. 300-313, 2005.

ROCHA, S. A. et al. Fibras e lipídios em alimentos vegetais oriundos do cultivo orgânico e convencional. **Revista Simbio-Logias**, v.1, n.2, p.1-9, 2008.

ROCHA, D. R. C. et al. Macarrão adicionado de *ora-pro-nobis* (*Pereskia aculeata* Miller) desidratado. **Alimentos e Nutrição**, v.19, n.4, p.459-465, 2008.

SANTOS, M. B. et al. Caracterização e qualidade de frutos de umbu-cajá (*Spondias tuberosa* xs. Mombin) provenientes do recôncavo do Sul da Bahia. **Revista Brasileira de Fruticultura**, v.32, n.4, p.1089-1097, 2010.

SATO, A. P. S. et al. Consumo alimentar e ingestão de ferro de gestantes e mulheres em idade reprodutiva. **Revista Latino Americano em Enfermagem**, v.18, n.2, p.113-121, 2009.

SILVA, K. M. et al. Elaboração de néctar misto de umbu-cajá, couve-flor e gengibre: caracterização físico-química e sensorial. **Revista Brasileira de Agrotecnologia**, v.5, n.1, p.09-17, 2015.

SOUZA, M. R. R. O. et al. potencial do ora-pro-nobis na diversificação da produção agrícola familiar. **Revista Brasileira de Agroecologia**, v.4, n.2, p.3550-3554, 2009.

STORCK, C. R. et al. Folhas, talos, cascas e sementes de vegetais: composição nutricional, aproveitamento na alimentação e análise sensorial de preparações. **Ciência Rural**, v.43, n.3, p.537-543, 2013.

STORCK, C. R. et al. Qualidade microbiológica e composição de farinha de resíduos da produção de suco de frutas em diferentes granulometrias. **Brazilian Journal of Food Technology**, v. 18, n. 4, p. 277-284, 2015.

SWEETMAN, C.; WARDLE, J.; COOKE, L. Soft drinks and 'desire to drink' in preschoolers. **International Journal of Behavior Nutrition and Physical Activity**, v. 50, n. 60, 2008.

TAKEITI, C. Y. et al. Nutritive evaluation of a non-conventional leafy vegetable (*Pereskia aculeata* Miller). **International Journal of Food Science and Technology**, v.1, n.60, p.148-160, 2009.

VITOLO, M. R.; CAMPAGNOLO, P. D. B.; GAMA, C. M. Fatores associados ao risco de consumo insuficiente de fibra alimentar entre adolescentes. **Journal of Pediatric**, v.83, n.1, p.47-52, 2007.

WEAVER, C. M.; HEANEY, R. P. Food sources, supplements, and bioavailability. In: WEAVER, C. M.; HEANEY, R. P. (Edit). **Calcium in Human Health**. Totowa: Human Press Inc, 2006.