ARTIGO ORIGINAL

Review of literature: carotenoids, chemical composition and dietary reference intake of buriti fruits

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ABSTRACT

Although fruits and vegetables, sources of carotenoids, are widely available in Brazil, hypovitaminosis A constitutes a serious public health problem. There is lack of information available to the population about the dietary sources of carotenoids and factors affecting their bioavailability.

The carotenoids also known as bioactive compounds have been associated with the reduction of the risk for degenerative diseases, such as cancer (modulators of immunological responses), cardiovascular diseases, macular degeneration and cataract.

In Brazil the utilization of buriti fruit is not widespread; it is consumed only by the local population of some parts of the North and Central regions. Among those foods, out the foods of buritizeiro, the buriti has the highest content of β-carotene among the numerous foods already analyzed, as well as a source of oleic fatty acid, similar to olive oil.

The buriti fruit provides the needs of DRI's (Dietary Reference Intake) of vitamin A for adult, being a good source of nutrition, knowing the variety of foods that composes a balanced diet. Also, the buriti fruit is a natural source of β-carotene (provitamin A). Also, it has antioxidant power by having carotenoids, polyphenols, vitamin C compared to other vegetables, can be considered a functional food.

KEYWORDS: buriti fruits, carotene, functional foods

INTRODUCTION

It is public the relationship between the feeding and the incidence of certain diseases, as for instance, the high incidence of chronic – degenerative illness as the cardiovascular diseases, the diabetes mellitus no insulino -dependent and different cancer types. It is also recognized that the diet, as a part of healthy lifestyle, has a preponderant paper in the prevention and cure of those diseases. The foods that carry out that function received name of functional foods [1](MANHÃES, 2007).

Hypovitaminosis A causes xerophthalmia, blindness and death in thousands of children throughout the world and constitutes one of the main nutritional problems in the populations of developing countries, including Brazil. Although fruits and vegetables, sources of carotenoids, are widely available in Brazil, hypovitaminosis A constitutes a serious public health problem. The lack of information available to the population about the dietary sources of carotenoids and factors affecting their bioavailability [2](AMBRÓSIO et al, 2006). Until the release of the new nutrient recommendations from the American Institute of Medicine [3](U.S. Institute of Medicine, IOM, 2001), the conversion factors used to calculate the vitamin A value of a food of vegetable origin were defined as 1μg retinol or 12 μg of α-carotene or 6 μg of β-carotene corresponding to one RE (retinol equivalent) [4](NAS-NCR,1989). In 2001, the Institute of Medicine (IOM) released the DRI's

(Dietary Reference Intake) for vitamin A and other nutrients with nutrition recommendations for the American and Canadian population. In this publication, the institute found new conversion factors of provitamin A, evaluating two parameters: the conversion efficiency of β-carotene to retinol and its absorption rate. The new recommendations maintains the estimated conversion efficiency of 50%, as before. The equivalence ratio of β-carotene: retinol was kept 2:1. Accordingly, the new conversion factors of provitamin established by [3](IOM, 2001) are twice the factors used until last recommendation. The Institute of Medicine introduces a new concept, the equivalent Retinol Activity (RAE). Each Activity Equivalent Retinol corresponds to 1ug of retinol or 12μg β-carotene or 24ug β-carotene or other carotenoids [3](IOM, 2001). It is considered that as absorbed, β -carotene from a mixed diet or supplement follows the same metabolic routes, which justifies the user as a factor of 50% conversion efficiency of β-carotene to retinol for both β-carotene from a mixed diet so as to supplement [5](CAMPOS&ROSADO, 2005).

Carotenoids are derived from tetraterpenes (C_{40}) hydrocarbon skeleton consisting of eight isoprenoid units. In nature, carotenoids emerge from the coupling of C_{20} analogue farnesyl pyrophosphate, leading to formation of phytoene. The phytoene through dehydrogenation reactions, cyclization and oxidation give rise to a variety of pigments (C_{40}) the abundant β - carotene and lycopene. The carotenoids formed only by carbon atoms and hydrogen are referred to as carotenes. The carotenoids also known as bioactive compounds have been associated with the reduction of the risk for degenerative diseases, such as cancer (modulators of immunological responses), cardiovascular diseases, macular degeneration and cataract. The mechanism of action of carotenoids as antioxidants in vivo is not yet determined, but is believed to be related to their ability to interact with ion radicals and reactive oxygen species. [6,7](CARDOSO,1997; RODRIGUEZ-AMAYA, 2004).

Of the various functions attributed to carotenoids (natural pigments), in many foods such as fruits, vegetables, egg yolk, skin and flesh of some fish. Both provitamin A carotenoids such as β-and α-carotenes and cryptoxanthins are partly converted to vitamin A, primarily retinyl esters, in the intestinal mucosa, and both carotenoids and retinyl esters are incorporated into chylomicrons and secreted into lymph for delivery to the blood stream, where the chylomicrons are rapidly degraded by lipoprotein lipase. The resulting chylomicron remnants containing carotenoids are rapidly taken up by the liver. [8,9,10,7,11](SENTANY & AMAYA, 2007; OLSON, 1989; HUGHES, 2001; RODRIGUEZ-AMAYA, 2004; YEUM & RUSSEL, 2002).

BURITI FRUIT

Dates in the literature describied provitamin A activity of some carotenoids (provitamin A) in buriti [12,7](GODOY & RODRIGUEZ-AMAYA, 1995; RODRIGUEZ-AMAYA, 2004).

Although the Amazonian area has enormous vegetable and animal biodiversity, many of them still need to be studied, therefore, it is believed that are potential sources of countless functional properties. Among those foods, out the foods of buritizeiro, the buriti has the highest content of β-carotene among the numerous food already analyzed, as well as high levels of α-carotene and ʏ-carotene, other provitamin A (β- cryptoxantina) [7](RODRIGUEZ-AMAYA, 2004).

Buriti palm is included in a little group of palms called “trees of life”, all of which it is used [13] (SILVA, 1991).

The oil extracted from the buriti palm (Mauritia flexuosa-family Arecaceae),, one of the main species of the Brazilian Cerrado is found along water course one poorly drained, swamp or flooded soils and its parts are used extensively by the local populations wherever it occurs. Also, in the area of Lençóis Maranhenses (Brazil) the buriti palm can be considered the symbol species of the region and its high importance sociocultural, economic and environmental [14](SARAIVA, 2009). There are a variety of applications such as fruit for the production of wines, spirits and roots for medicinal use [15](PEREIRA, 2008).

REVIEW OF LITERATURE CAROTENOIDS: BURITI FRUIT

Some dates in the literature describied content of of β-carotene content in the buriti fruit (several species) by different methods.

The carotenoid composition and vitamin A value of “buriti “(Mauritia vinifera Mart.) were determined. Of the nine carotenoids identified, eight were determined (13 - cis- α-carotene, α-carotene, 13 - cis β –carotene, β –carotene, 9-cis- β-carotene, ζ-carotene, β - zeacarotene and Ƴ-carotene) and only one was a xanthophylls (zeaxanthin). The provitamins A: β–carotene, α-carotene, and Ƴ-carotene were the main pigments, representing 70. 16 and 7% of the total carotenoid content (513± 30 μg /g). With mean vitamin A value of 6.992 and 6.489 RE/100g, calculated with and without out isomer separation, respectively, buriti proved to be one the richest sources of provitamin A. [7-12](RODRIGUEZ-AMAYA, 2004; GODOY & RODRIGUEZ-AMAYA, 1995).

Another works about buriti , the results of carotenoids were: α − carotene (4.4 a13.0 µg/g) and β– carotene (253.0 a 262.0 µg/g). The amount of 4104ug RE reported for 100g of edible portion of the buriti. In Brazil the utilization of buriti is not widespread; it is consumed only by the local population of some parts of the North and Central regions, where the palm tree grows wild. 16,17(TAVARES et al, 1996; MARIATH, 1989).

Also, pulp of the buriti (Mauritia flexuosa, Mart.) was extracted with supercritical CO_2 (carbon dioxide) to obtain oil fractions with a high concentration of vitamins, especially β-carotene. The raw material consisted of a mixture of pulp and peel that was scraped off the immature fruit. The extracted oil was analyzed by gas chromatography and spectrophotometry, and results were compared with those obtained by extraction using hexane as solvent. The oil extracted with hexane showed a content of about 1% carotene. Extraction with supercritical CO_2 was capable of removing about 80% of the initial carotene content. Extraction experiments were carried out at pressures of 20 and 30 MPa (Megapascal) and temperatures of 313 and 328 °K. The extraction curves typically showed the three regions found in supercritical fluid extraction of natural products, *i.e.* beginning with a straight line characteristic of the constant rate extraction period, followed by the falling rate period, and ending with the diffusion rate period. Experimental data were correlated using the model proposed by Sovová. The model showed good agreement with experimental data. The mass transfer coefficients of the solid phase were obtained by adjusting the model equation. The solubility values calculated are within the range for common vegetable oils [18](FRANÇA, et al 1999).

In another work, Ribeiro et al, [19](2012) studied, at the extraction and concentration of β-carotene from crude and refined buriti oils using enzymatic hydrolysis as a process strategy. The performance of two commercial lypolytic preparations as wel as lipases from Yarrowia lipolytica, was evaluate. The paramaters considered in the hydrolysis process were temperature, enzyme loading and ratio buriti oil/water. Based on a previously conducted statistical design, the experimental conditions were set in order to maximize the free fatty acids (FFA) content in the oil and simultaneously, minimize the loss of carotenoids. As lypolytic preparations, showed to be the most appropriate enzyme source for the hydrolysis of both oils. The optimized conditions determined for the crude buriti processing were 31°C, 0,0047 g lipase mL-1 (0.47 g lipase per 100mL reactional mixture) and (2.33 ratio oil/ water), while for the refined oil, 45°C, 0,0066 g lipase mL-1 and 1.80 were the best conditions. At the optimized conditions the maxima the free fatty acids (FFA) release were 73.0% and 74.8% and total carotenoids contents were 1578 and 793 mg kg-1, respectively for the crude and the refined buriti oils, after 4 hours of reaction, agited at 300 rpm. Following hydrolysis, oils were deacidified by winterization or phases partition with ethanol.

CHEMICAL COMPOSITION

From the nutritional point-of-view, of buriti pulp fruit (Mauritia vinifera Mart.) in their chemical composition in relation to carbohydrates were between: (10.6 -13.2g/100g). The lipidic fraction of the pulp corresponded to 13. 85%, presents a high degree of insaturation due especially to oleic acid content (72.6 -74.6%), similar to olive oil [20,1](CODEX, 2003; MANHÃES, 2007). The results obtained were: for vitamin C (19.8 ± 0.8) mg/100g and calcium (120.1± 25.0)mg/100g, [21](TAVARES et al, 2003).

In this study, revelead that the buriti pulp has 62.93% of humidity on average, 8.25% of total carbohydrates, being 5.17% of this fraction of total alimentary fiber, 2.10% of protein with predominance of the sulphurated amino acids and of the tryptophane, what is surprising for being a protein of vegetable origin. The study dispose 0,94% of total minerals prevailing the elements K, Ca, Mg, Mn, Zn, Cu, Se, Cr, I. Addition of 56mg/100g of ascorbic acid [1](MANHÃES, 2007).

ANTIOXIDANT CAPACITY

In the literature, the authors describied the antioxidant power of buriti.

Carotenoids known as β-carotene is the yellow pigment found in fruits and vegetables and their antioxidant role of interact with radicals ions and reactive oxygen species [6](CARDOSO, 1997).

The study found the antioxidant power of this pulp as a function of the results of carotenoids, and total polyphenols, where 100g pulp contains 23 mg of total carotenoids, and the β -carotene content was 13.71 mg / 100g, which was higher found in the cabbage and carrots. Contains 9.47 mg of polyphenols/100g pulp and higher than in cabbage and carrots, too [1](MANHÃES, 2007).

Koolen et al, [22](2013) reported the antioxidant, antimicrobial activities and characterization of phenolics from buriti leafs, trunk and fruit extracts. The total phenolics of the buriti extracts ranged from 378.07 ± 3.12 to 86.89 ± 3.15 mg GAEq/100 g (gallic acid equivalent) and flavonoid content ranged from 567.16 ± 1.15 to 246.84 ± 1.11 mg QUEREq/100 g (quercetin equivalent). These results indicate that antioxidant and antimicrobial activities in buriti phenolic extracts are quite potent and implicates the presence of compounds with potent free-radical-scavenging activity.

DISCUSSION

As current legislation [23](BRAZIL, 2005) the DRI's (Dietary Reference Intake) for adults vitamin A corresponds to 600 micrograms RE (retinol) being, 1 microgram retinol is equivalent to (=) 1 microgram RE; 1 microgram β – carotene = 0,167 microgram RE ; 1 microgram of other provitamin A carotenoids = 0.084 micrograms RE; 1 I.U (International Unit) = 0.3 micrograms retinol equivalent.

Comparing literature datas [12,16](GODOY & RODRIGUEZ - AMAYA, 1995; TAVARES et al, 1996), the buriti provides the needs of DRI's (Dietary Reference Intake) of vitamin A for adult, being a good source of nutrition, knowing the variety of foods that composes a balanced diet. Also, the buriti fruit is a natural source of β – carotene (provitamin A).

The buriti has antioxidant power by having carotenoids, polyphenols, vitamin C compared to other vegetables, can be considered a functional food [1](Manhães, 2007).

Carotenoids are natural pigments, constituents of foods, some of which are precursors of vitamin A. Investigation of the factors that influence carotenoid composition in foods are: the existence of a very large number of carotenoids, the qualitative and quantitative variation in the composition of food, the very wide range of concentrations in which the carotenoids are found in food, the susceptibility of carotenoids to the isomerization and oxidation during storage and before sample analysis. Besides, these factors can be considered: the variety or cultivar, stage of maturation; climate or geographic location; plant part used and production technique. [7](RODRIGUEZ-AMAYA, 2004).

The best long - term, approach to the control and prevention of hypovitaminosis A is of course to increase the consumption of foods containing vitamin A activity, and provitamin A carotenoids. However, the foods that are part of the daily diet in the Northeast of Brazil are: cassava, beans and maize; the diet of this population is very poor in vitamin A and carotenoids and also contains little fat.

Any attempt to introduce dark-green leafy vegetables into the diet would face problems because in the Northeast, in its semiarid regions, green leaves are considered suitable for animal feed. The fibrous pulp and oil of buriti can be consumed fresh and constitutes a natural reserve of provitamin A (carotenoids), higher than pequi oil. These fruits have significant levels of Vitamin C and Calcium [17,21](MARIATH et al, 1989; TAVARES et al, 2003).

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Table 1 - Activity of some carotenoids (provitamin A) in buriti

Carotenoids	Aticvity(%)
α- carotene	50-54
β - carotene	100
β - zeacarotene	20-40
ϒ - carotene	27-42