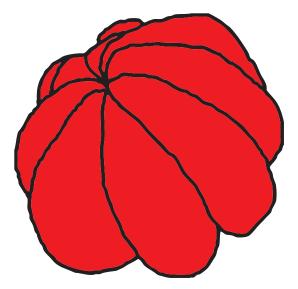


The most Brazilian of all fruits in cooking, cosmetics and health



Luiz Grossman In collaboration with Gabriel Zitune and Letícia Bertazzi





1st Edition Copyright © 2010 Luiz Grossman, Gabriel Zitune and Letícia Bertazzi March 2010

All rights reserved by **OPTIONLINE Ltda.**

Rua Herculano de Freitas, 390

Bela Vista – 01308-020 – São Paulo – SP – Phone (55 11) 3159-2470 – www.optionline.com

Final Edition: Luiz Grossman Recipes: Gabriel Zitune Photographs: Luiz Grossman Design Concept, Production and Cover: Dagui Design Revision: Ricardo Paulo Novais and Cristina Galhardo Illustrator: Ivo Minkovicius

Grossman, Luiz Magical Pitanga Cherry: the most Brazilian of all fruits in cooking, cosmetics and health / Luiz Grossman ; with collaboration with Gabriel Zitune and Leticia Bertazzi. – São Paulo : Optionline, 2010.		
Bibliography		
1. Cosmetics from fruits 2. Cooking with fruits 3. Essencial oils 4. Pitanga Cherry crop 5. Pitanga Cherry – Therapeutic use 6. Natural health		
10-1491	CDD-661.806	
ISBN 978-85-99107-21-8		

ISBN 978-85-99107-28-8

No part of this publication may be reproduced, stored in a retrieval system, or transmitted in any form or by any means, electronic, mechanical, photocopying, recording, or otherwise, without the prior consent of the publisher.

Luiz Grossman

Magical Pitanga Cherry

The most Brazilian of all fruits in cooking, cosmetics and health

In collaboration with Gabriel Zitune and Letícia Bertazzi

São Paulo Optionline 2010

This book is dedicated to our parents for teaching us all they knew, our spouses for sharing their love and our children to whom we hope to pass on all we have learned.

Luiz Grossman

Is an agricultural engineer and a Brazilian fruit lover.

Gabriel Zitune

Is a an attorney and an experimental cooking lover.

Letícia Bertazzi

Is a doctor, specialized in aesthetic medicine and dermatology through natural products.

Aknowledgements

Our thanks to

Cristina Galhardo for her patience in reading, re-reading and suggesting improvements to this work.

Paulo Aspis, Regis Horta and to the Atta Mídia e Educação team for sharing the video about the Pitanga Cherry.

Adriana de Almeida Barreiros, from the USP (University of São Paulo) Library of Chemistry who helped us find several scientific works.

Ivo Minkovicius who, besides creating this book's wonderful design, helped us in every other way to bring this project to life.

Carlos Andreotti, for his patience and care in processing the photos.

Roberto Saad and Nelson Bushatsky for the final touches to this book.

José, Noel, Luiz and Manoel Dias, brothers and Pitanga Cherry producers who also put their faith in this fruit.

Leodil, Gino, Eliana and all the team at Garden City Farm who, with their endless good will, helped with all the researches on the Pitanga Cherry.

Maurício Eugênio and team, for their invaluable help in promoting this project.

The Trancoso Carpentry Shop who kindly provided the decoration items photographed for the recipes.

Table of Contents

11 Introduction

15 Chapter 1 - Pitanga Cherry, the Plant

17 Botany

20 The Biology of the Pitanga Cherry Tree

- 20 Propagation
- 21 Growing tips

23 The Chemistry of the Pitanga Cherry

- **23** The essential oil
- 25 Identifying the essential oil of Pitanga Cherry
- 30 The distillation of the essential oil of Pitanga Cherry
- 32 The extract of Pitanga Cherry

33 Bibliography of Chapter 1

35 Chapter 2 - Pitanga Cherry Health

- **38** Functional food: the importance of carotenoids in human health
- 42 Antimicrobial and anti-irritant action: the wealth of the essential oil from Pitanga Cherry leaves
- 45 Future possibilities: the threshold of pharmacological research with active substances of the Pitanga Cherry
- 45 Hypothermic and antinociceptive actions
- 45 Anti-diarrheal activity
- **45** Antioxidant effect of flavonoids
- **46** Antitumor activity of the essential oil
- **48** Induction of phytoalexins: the altruistic Pitanga Cherry
- **50** Pitanga Cherry Sentinel: helping the people of the big cities

51 Bibliography of Chapter 2

53 Chapter 3 - Pitanga Cherry Beauty

55 Anti-aging Pitanga Cherry: richness in carotenoids

58 Challenges in developing cosmetics and the role of the Pitanga Cherry

- 59 Acneic skin and Vitamin A
- 62 The essential oil of Pitanga Cherry aids in the treatment of acne

64 Bibliography of Chapter 3

67 Chapter 4 - Pitanga Cherry Perfume

71 Does sex begin with scent?

78 Bibliography of Chapter 4

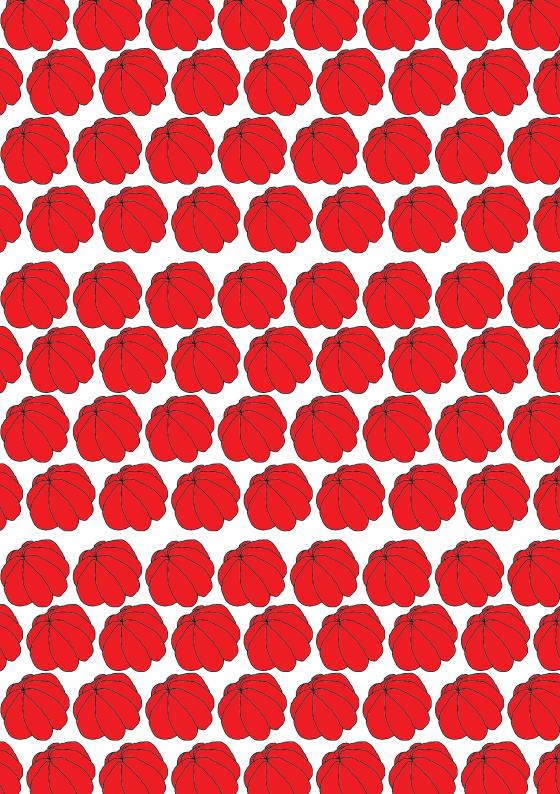
81 Chapter 5 - Pitanga Cherry Flavor

Basic Recipes for savory foods

- 85 Basic Pitanga Cherry sauce
- 85 Pitanga Cherry dressing
- 86 Marinated salmon salad with Pitanga Cherry sauce and almonds
- 88 Hearts-of-palm salad with smoked salmon and Pitanga Cherry sauce
- 90 Tricolor salad with raspberry and Pitanga Cherry sauce
- 92 Smoked haddock salad with dry curd and Pitanga Cherry sauce
- 94 Gnocchi carotene with Pitanga Cherry sauce
- 96 Black rice risotto with Pitanga Cherry sauce and mint
- 98 Portuguese sausage with sauerkraut cooked chicken with Pitanga Cherry sauce
- 100 Chicken rolls with Pitanga Cherry sauce and baby carrots
- 102 Duck breast with Pitanga Cherry sauce, Morocco couscous and asparagus
- 104 Grilled whiting with Pitanga Cherry sauce, red onion and beetroot
- 106 Roast bass with almonds and Pitanga Cherry sauce potatoes
- 108 Bicolor bass with Pitanga Cherry sauce and hearts-of-palms
- 110 Meatballs with Pitanga Cherry and jabuticaba sauce
- 112 Roast tenderloin with beans and lentils in Pitanga Cherry sauce
- 114 Roast maminha with olive and Pitanga Cherry and pomegranate sauce

Basic Sweet Recipes

- 117 Pitanga Cherry syrup
- 117 Pitanga Cherry jam
- 118 Pitanga Cherry pie with pistachio candy
- 120 Buffalo ricotta pie with pistachio, marmalade and Pitanga Cherry
- 122 Pitanga Cherry cake
- 124 Mascarpone foam with coconut and vanilla, Pitanga Cherry jam and marshmallow
- 126 Marshmallow dessert with raspberries and Pitanga Cherry syrup



Introduction

It has been ten years since we got involved with this wonderful and full of secrets Brazilian fruit we call "pitanga" (Pitanga Cherry).

Everyone, at least in small Brazilian towns, has a Pitanga Cherry tree in their backyards, knows someone who has one or has tried to pick its small fruit from somebody else's yard. No one dislikes its sweet and sour taste and everyone says it reminds them of their childhood.

As for us, it all started out with a tree in my farm, Garden City, located in a small town in São Paulo. Our experiments with medicinal and aromatic plants were at full speed when we decided to chart the plants with potential for producing essential oils. So we built a small distillery (which was further enlarged and improved) and set out to "discover" the unique Brazilian fruits and their oils. We charted over 300 plants, and to obtain some specimens we had to travel hundreds of miles. Meanwhile the Pitanga Cherry was still there, in our backyards, nice and dandy.

One day we decided to try an experiment with the Pitanga Cherry and noticed it released a kind of essential oil which was very different from any other. We took the few droplets we could extract to three perfumer friends who gave us their verdict: it was very different from everything around, precisely because of its unique aromatic profile among other plants, but of no market potential.

We were intrigued. The essential oil we extracted did not represent precisely the sweet and sour flavor of the fruit, but boasted some special characteristics. Besides its different and pleasant fragrance, it tasted extremely good when appropriately diluted. It meant that besides the possibility of its use in the making of perfume it could be of value in cooking and, maybe, in health. At the time we were still involved in the researches that resulted in our first book – Essential oils in cooking, cosmetics and health - and that was enough to grant the Pitanga Cherry a short monography and ensure it went down in history, selected among hundreds of plants to deserve space in our publication.

> It seems the Pitanga Cherry, with its sour flavor, also has its tricks and decided to reveal its personality little by little. We decided to retrace the path followed by the researchers who had studied it. First we tested its essential oil activity as an anti-microbial agent. It worked. After that, we noticed its anti-irritant potential and decided to sponsor another research to prove it. It worked. We followed the recommendations of the researchers and decided to test the anti-tumor activity and guess... it worked again. It was some time later that, by chance, as we were doing research in the US Department of Agriculture nutritional information database - with incredible detailing on thousands of foods worldwide that we found it was the fruit with the world's highest amount of carotenoids. It seemed that every time we put the Pitanga Cherry to test it proved unbeatable. Afterwards, the safety tests came - what good is an active substance that works but causes uncountable problems? We did all tests possible and found that the Pitanga Cherry essential oil did not have toxic effects, even at the maximum dosages adopted in the studies. That meant it was guite safe. We formulated cosmetics and foods with the Pitanga Cherry and the tests with humans also worked out fine.

At that time our Pitanga Cherry orchard counted over 500 trees. Year after year, we collected seeds from our orchard and tested new replication mechanisms. In that front not all experiments were successful. It looks like this daring fruit, astutely, always kept some secret for the next round. We then started to research what others had already found about it. The result: we were astonished! The lines of research displayed unimaginable pharmacological activities, for instance, the use as a vegetal bio-stimulant, as an element to bio-monitoring of pollutants in big Brazilian cities and as a biodefensive. Besides all that, we learned that the Pitanga Cherry is used in Candomblé rituals. Gilberto Freyre made it immortal in his book Açúcar (Sugar), as a key ingredient of the Tropical Cognac – consumed and idolized by everyone at the time of the Brazilian Old Republic. The search engine Google unveiled other countless and very interesting uses in cooking, which we tested and approved. For all that, we thought it was worth telling the story of the Pitanga Cherry and spread its secrets to everyone.

Today Garden City farm counts 26 thousand Pitanga Cherry trees, which seem few to me. It gives us the assurance that we will continue researching and gradually discovering its other facets.

The Pitanga Cherry, my wife and I are a case of passion and we would like to share with you, reader, some of what we feel for this fruit which, in our opinion, is all about Brazil. By the way, in this book we will use the term "Pitanga Cherry tree" as well as "Pitanga Cherry" to name the plant. Both the fruit and the plant are one and the same.

Agricultural engineers Luiz and Janice Grossman





Chapter 1 Pitanga Cherry, The Plant



Botany

"Pitangueira" is the plant's popular name in Brazil, scientific name *Eugenia uniflora* L., a species belonging to the Myrtaceae family, consisting of over 100 genera and 3600 species of plants.

In this family we find plants such as the guava, the jabuticabeira, black pepper, the jambolão and the eucalyptus – just to name a few of its best known representatives - and it is spread all over the planet, but mainly in the Americas, Australia and East Asia.

The Pitanga Cherry is native to Brazil and can be found in all its regions. Besides the name "pitanga" it is also known as "ibitanga" and "pitangatuba". Outside the country, it is also found in Argentina and Paraguay, where it is known as "nangapiri", and in the United States, where there are also commercial plantations, it is known as Brazilian or Surinam cherry.

The name "pitanga" comes from the word *pitāg*, which in the Indian Tupi language means "dark red". Interestingly, in Tupi, "pitanga" also means "child". Although it is not a source of confusion, here we have the first indication that the plant reminds us of childhood, as many would say.

The Pitanga Cherry gives us several reasons to consider it a truly Brazilian fruit: it grows both in tropical and subtropical climates, tolerates a wide variety of soils, is generally resistant to frost and enjoys intense heat. Across the country the plant is valued for its lovely fruit, sweet and sour taste and attractive color. It also carries numerous therapeutic properties and a unique aroma that emanates from the leaves, and this distinguishes it from all other plants

Because of its hardiness, ease of



cultivation and beauty, the Pitanga Cherry has spread throughout the country and later all over the world. It is easy to find it in small orchards and in urban landscaping.

The fruit has an average composition of 66 to 77% pulp and 23 to 34% seeds, which is also rich in calcium, phosphorus, anthocyanins, flavonoids, carotenoids and vitamin A. The Pitanga Cherry leaf is rich in essential oils and flavonoids, which are responsible for its very interesting pharmacological properties which are presented next.

The Pitanga Cherry is a small semi-deciduous tree (its leaves fall in winter) which grows slowly, reaching an average 8 to 10 meters in height. Its trunk is often



tortuous and highly branched. The leaves are opposite, dark green, glossy and oval. When young, they display a characteristic purplish color. The flowers are white, mildly perfumed, rich in honey and pollen, are hermaphrodites and have a small amount of nectar. The fruit is a berry of 1.5 to 3 cm in diameter, juicy pulp, with its color ranging from yellow or orange to dark red or even black when ripe. It displays 8 to 10 longitudinal grooves/ridges, generally with one seed but may carry two or three.

In subtropical climates the plant blooms mainly in spring and bears fruit in October and January. In warm climates it produces an additional harvest between April and July in the southern hemisphere.



ANGA 18 ERRY



Table 1 – Nutritional composition of the fruit

Nutritional value per 100g		
Energy	33–51 Kcal	
Moisture (water)	85,00–90,00%	
Protein	0,80 g	
Fat	0,40 g	
Carbohydrates	7,50–12,50 g	
Fiber	0,60 g	
Ash	0,50 g	
Vitamin A	635 mg (75 RAE)*	
Thiamin	0,030 mg	
Riboflavin	0,04–0,060 mg	
Niacin	0,30 mg	
Ascorbic acid	14–26 mg	
Calcium	9 mg	
Phosphorus	11 mg	
Iron	0,20 mg	
Potassium	103 mg	

*RAE (Retinol equivalents) Sources: Vilachica and the US Department of Agriculture Food Nutrition Tables.

The Biology of the Pitanga Cherry Tree

Propagation

The main spreading method is through the seed. When creating seedlings, it is important to use substrates containing adequate physicochemical properties that can provide the nutrients required for the development of the plant. There are several substrate options available in the market and it is also possible to prepare a substrate on site, through a mixture of humified manure and soil (1:3). Anyway, it is essential to supplement the substrate with phosphorus due to the great requirement of the seedlings for this nutrient. 6 kg per m3 of plain superphosphate substrate (mineral fertilizer) must be incorporated or bone meal (organic fertilizer) must be added in the same proportion. It is also important to avoid the use of nitrogen or mixtures of fertilizers containing nitrogen or substrates at the beginning of rooting. Coverage with nitrogen fertilizer supplements is recommended in later stages of the seedlings, a few weeks after sprouting. It is further recommended to supplement with foliar fertilizer for that end.

The root of the Pitanga Cherry is pivotal. Thus, it grows very quickly in depth at the expense of axial growth. For planting, we suggest the use of plastic bags with a minimum depth of 20 cm. Smaller bags will likely prevent the growth of the root and therefore of the seedling before it reaches the optimal size for transplanting. Normally, the seedlings are ready for transplant between 6 and 9 months after sowing. In commercial plantations it is recommended grafting the seedlings to ensure greater consistency and productivity. There are several varieties of Pitanga Cherry tree, especially in the Northeast of Brazil, which were selected in order to produce fruit. There are not any varieties selected for the production of leaves yet.



Growing tips

The seedlings are readv for transplanting when they reach an average height around 20-25 cm. They stop growing when nutrients are depleted or when the root has no more room to penetrate perpendicularly. So, nutrient replenishment and deep bags are essential. Seedlings should be transplanted in lumps, which means carefully removing the plastic bag without breaking the lump of land that surrounds it. The transplant is done early in the rainy season, to guarantee enough water during the post-transplantation phase. Small seedlings are also very sensitive to cold and frost, so the transplant in south and southeastern Brazil seldom begins before November.

If the goal is the commercial production of fruit, the usually suggested spacing is 4 x 4 m between the trees. If the goal is the production of leaves, spacing with higher yield, which we have tested, is 1 m (in line) by 1.5 m (between rows). Open pits should be approximately 0.35 x 0.35 x 0.35 m - where lime and fertilizer for planting should be incorporated, which varies depending on the type of soil. Nutrients exported from the plantation should be replenished annually, remembering that fruit



production exports a lot less nutrients from the plant than the production of leaves. Planting aiming at the extraction of leaves causes a more rapid depletion of soil nutrients, which should, in such cases, be heavily replaced with fertilizer, preferably organic, in greater quantities and frequency. We usually apply 2-4 kg of humified manure per tree yearly, depending on the age of the plant.

Depending on the region and type of soil, the production of leaves usually precedes the season of fruit in a year time. In the Brazilian Southeast, the first cut usually occurs around the third year after transplantation. Commercially, fruit production starts from the fourth to the fifth year in milder or cold climates; in warm regions, fruit grow already from the second year.



The chemistry of the Pitanga Cherry

The essential oil

Essential oils are volatile, aromatic substances produced by some plants. Many consider the essential oil equivalent to the soul of the plant because it is this substance produced by the plant that lends it the delicious scent and taste for which it is known. Unlike the fixed oils (fatty), essential oils are produced in small amounts and are quite volatile (therefore, their smell quickly spreads around the whole environment). It usually takes several tons of fresh plants to produce just one kilogram of essential oil. It means that a single drop (or less) of oil is aromatically equivalent to several hundred grams of leaf - which opens up numerous possibilities in the culinary and cosmetic arts.

Table 2 – Yield of essential oil

	Approximate amount of fresh plant to produce 1kg of essential oil	Area in m ² for production of 1kg of essential oil
Ginger (roots)	3000 kg	15,000 m ²
Chamomile (flowers)	4000 kg	16,000 m ²
Pitanga Cherry (leaves)	1000 kg	10,000 m ²

Average values obtained in experiments conducted by the author.

Essential oils are a class of substances with a lipophilic nature, thus being called "oils", but are quite distinct from traditional vegetable oils such as olive oil, sunflower oil, soybean etc.. The latter are of glyceridic nature, i.e. they are composed of fatty acids and glycerol. Essential oils are also called volatile oils, because at room temperature they tend to evaporate - and this is why we can perceive their flavor almost immediately. As a counterpoint, fatty vegetable oils are also called fixed, because they do not vaporize at room temperature.

The essential oil takes on a different role for the plant due to the organ in which it is was produced. Typically, the oils contained in the leaves, roots and

23 PITANG

bark are associated with the survival of the plant, working in its defense against micro-organisms such as fungi and bacteria. The essential oils produced in the flowers work mainly to attract pollinators like birds and insects. When insects, bats and birds visit flowers to feed on pollen, they usually pollinate the flowers in the process. The color and odor of the flower are important instruments in attracting these agents. Odor is particularly important to attract nocturnal pollinators such as moths and bats, so flowers pollinated by these agents usually exhale a lot more perfume. The nature of odors also selects the type of pollinators. The Pitanga Cherry is often visited by bees, and possibly by other insects. In fruiting season, it also attracts birds. You may see how it happens with other plants in general in the table below:

Table 3 – Pollinator's preferences

Kind of floral scent exhaled	Pollinator attracted
Sweet and light aromas	Bees and butterflies
Sweet and heavy aromas	Moths
Musk or rotten fruit	Bats
Foul odor	Beetles and flies



Identifying the essential oil of Pitanga Cherry

The Pitanga Cherry produces essential oils primarily in the leaves, but also, to a lesser extent, in the flowers and fruits. This book will deal exclusively with the essential oils produced in the leaves. Firstly, because the amount of essential oils in the leaves is much higher and, commercially speaking, remains the only option. Secondly, because it does not depend on seasonality - leaves are produced year round and in much larger amounts per planted area than flowers and fruits.

The composition of essential oil from leaves is not unique but rather a mixture of aromatic substances. It varies from place to place, depending on the chemotype of the plant, geographic origin, climate, season and soil characteristics. Still, it is possible to distinguish the essential oil of Pitanga Cherry from others. All essential oils have a sort of "fingerprint" that identifies them. In the case of Pitanga Cherry, its essential oil has unique characteristics, a unique combination of substances not found in other essential oils, in a proportion that gives it its unique identity.

You can identify the essential oil of Pitanga Cherry with the use of different methodologies and equipments. The two most usual are gas chromatography and physicochemical analysis. The first technique is more complex, expensive and time consuming, since it allows the isolation of all the components that are part of this complex mixture called essential oil. The graph resulting from this analysis is called the chromatogram, which we can consider the "fingerprint" of the oil. Through this method, we are not only able to identify all components present, but also in what proportion they are present (relative abundance in comparison to the others). Manufacturers of herbal and medicinal products usually make use of this methodology to standardize and isolate the components of interest within the essential oils.

The second technique, physicochemical analysis, is much faster and more affordable. It does not identify which substances are present in the essential oil, but can determine if we are really talking of the essential oil of Pitanga Cherry or another plant. To some extent, this method can also identify adulteration of essential oil. Within predefined parameters, it allows the identification of some physical and chemical properties of the essential oil, which usually remain stable even after variations in climatic, geographical or different harvests. The producers of essential oils, farmers in general and wholesalers usually make use of this methodology to standardize the essential oils supplied.



The three physicochemical properties most commonly used to standardize the essential oils are density, optical rotation and the refractive index. We may add to these the pH, due to its measuring convenience. In general, the combination of these four types of measurements identifies the essential oil from a plant in comparison to others, such is the case of the Pitanga Cherry. The devices commonly used to determinate density, optical rotation and refractive index are respectively the volumetric flask with a precision scale, the polarimeter and refractometer. The calculation of pH is not required, but may be of interest to your research.

Сгор	рН	Density	Optical Rotation	Refractive Index
2007	5.6	0.939	+43.35°	1.509
2008	5.3	0.955	+47.40°	1.510
2009	5.2	0.946	+49.80°	1.510

Table 4 – Physicochemical parameters of essential oil of Pitanga Cherry

Average physicochemical values measured by the author in different seasons.

Standardization of the properties of the essential oil of Pitanga Cherry		
Density	0.93 a 0.96	
Optical Rotation	+43 a 50°	
Refractive Index	1.509 a 1.510	
рН	5.2 a 5.6	

The author suggests that the physicochemical properties of pure, unadulterated essential oil of Pitanga Cherry, must be within these proportions.





Better understanding the physicochemical properties of essential oils:

Physicochemical properties do not allow us to assume one essential oil is better than another. They just allow us to identify whether or not there was tampering, when we comparing measurements made from a batch against the default.

Density: Due to ease of measurement and frequency of use in scientific literature, specific weight, or density is the main property considered in the rapid identification of an essential oil. Basically, it is the comparison of the weight of essential oil to the weight of water, taking equal volumes as basis. When the number obtained is lower than 1, as in the case of essential oil of Pitanga Cherry, it is less dense than water, and when in contact, it floats on water.

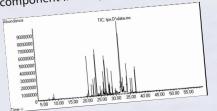
Optical Rotation: Many essential oils, when placed under a beam of polarized light, usually sodium, rotate the plane of polarization to the right or left at an angle that can be measured in an instrument called polarimeter. This angle is relatively constant for the same oil, even with changes of season, provided the same conditions of temperature and method of measurement are maintained.

Refractive Index: When a beam of light moves from a less dense to a denser substance, from air to the essential oil for example, it suffers refraction In comparison to its normal angle. Instruments called refractometers offer a rapid and reliable method of measuring the angle of refraction. At present, many refractometers directly calculate the refractive index, which is basically the ratio between the sine of the angle of incidence and the sine of the angle of refraction.

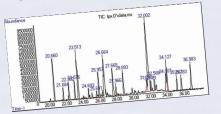
pH is a logarithmic scale that measures the degree of acidity of an aqueous solution. The lower the number, the greater the acidity.



Chromatogram of essential oil of Pitanga Cherry produced at Garden City Farm. Each peak usually represents a chemical substance, or a small group of similar entities. The larger the area under each peak the greater the relative abundance of the component in comparison to others.



Chromatogram of essential oil of Pitanga Cherry produced at Garden City Farm, expanded in the region of 15-40 min.





	Retention time (min)	Relative abundance (%)	Compound	
1	20.660	5.80	α-cubebene	
	21.684	7.34	α-copaene	
	22.382	10.31	β-elemenoe	
	23.076	11.41	α-gurjunene	
	23.513	35.76	trans-caryophyllene	
	25,957	3.73	germacrene D	
	26.572-26.664	0.80-9.73	curzerene	
	27.665	4.63	γ-cadinene	
	27.966	1.60	cubeneno	
	28.893	3.37	germacrene B	
	32.588	2.15	α-cadinol	
	34.127	3.80	germacrona	

 Table 5 – Chromatogram of essential oil of Pitanga Cherry produced at Garden

 City Farm (2007 crop)

As shown in Table 5, the main components of the essential oil of Pitanga Cherry are chemicals called sesquiterpenes. In the case of Garden City Farm, home of our production, the major component is trans-caryophyllene. In other regions, the major components may vary. For instance, in a study conducted in northeastern Brazil, the major components identified were selina-1,3,5(11)-trien-8-one and oxidoselina-1,3,7(11)-trien-8-one at levels of 48.52% and 17.33%; in another study conducted in Nigeria, caryophyllene, furanodiene and germacrene B were the major components. If the concentration of each component (relative abundance) varies even from region to region, and a substance may or may not be present due to its origin, we can infer that the therapeutic and aromatic properties should also vary. However, we note that oil produced by the same plantations, with crops obtained at the same times every year, present only a small variation in their chemical composition.



The distillation of essential oil of Pitanga Cherry

The process of extraction of essential oils from the leaves of Pitanga Cherry starts with the harvest, which resembles a drastic pruning. Young leaves and branches growing in the same year are cut, and the harvest can be done manually or using machines. Manual cutting, done with pruning shears, is more time consuming and expensive because it involves greater demand for labor, but causes less damage to the plants. There is an appropriate time to harvest the leaves, but it varies from place to place. The idea is to study the best combination of production of oil and type of components obtained and, especially, the destination you wish to give the essential oil. In the case of Garden City Farm, harvesting is done in Autumn, when growth decreases significantly and the amount of essential oil is still at large.

Just because essential oils are "oils", and volatile, the process of "extraction" may be carried by means of distillation. The word volatile originates from the Latin "Volare," which means "to fly." The distillation process of essential oils was perfected in the Middle Ages, around the eleventh century, with Avicenna, and evolved a lot over the years. However, its essence, no pun intended, remains the same.

CARGO

-

Notice that the correct terminology is to distill or to separate the essential oil, not to extract, since in distillation there is no chemical process, only the physical process of separation. Steam distillation, which is currently the most used technique, begins with the placement of leaves (with the branches) in stainless steel vats specially designed for this purpose, named stills. A boiler feeds the stills with steam from the bottom up.

One of a kind: the first mobile distillery projected and operated at the Garden City farm. It is easier to move the distillery as opposed to the crops.



Vapor under pressure, in contact the still at atmospheric pressure, undergoes rapid expansion and migrates upward dragging the volatile components along with the water from the leaves, which are also turned into vapor due to the temperature. The process of hauling may take around one to two hours until the mixture of water vapor and volatile components from the leaves reach the top of the still, where they are diverted to a condenser, whose function is to cool the system and turn all the components into liquid (distillate). Because the density of condensed distillate, which we call hydrosol, and of the essential oil in liquid state are very different - in general, most essential oils, including Pitanga Cherry's, are less dense than the hydrosol – essential oil floats on the hydrosol. Their separation is easy and done with a separator called florentine vase, which allows the separation of the essential oil and the hydrosol continuously, due to the differences in density between the two.

"I see myself, small, walking by a hedge of Pitanga Cherry trees. A low hedge, less than a meter. The small trees of Pitanga Cherry, all cut the same, low on the small cement path. The green leaves, very dark, some lighter, tender, soft. Just leaves, with no right to cherries. Leaves of strong taste, reminiscent of mint, when put into the mouth..." (Excerpt from "Pequenos pés de <u>Pitanga -Small Pitanga Cherry Trees</u>", by Luiz Britto, in *Contos de um Tempo Perdido*-*Tales of a lost time* - Salvador, 2002.)

The extract of Pitanga Cherry

As mentioned earlier, the process of distillation is exclusively physical, and usually does not impact the composition of substances. This method does not cause destruction or modification of volatile substances if the temperatures used do not harm the desired substances (cherry leaves are usually distilled at temperatures between 120°C and 140°C), especially when the molecules we want to separate are small and volatile. We do not always want to extract substances that fall into these categories.

The extraction of non-volatile chemicals contained in plants is achieved through the use of solvents. Each group of chemicals has affinities with specific solvents. That is, a particular solvent "drags" just a group of substances with which it has affinity. Various solvents are used for the extraction of phytochemical compounds. Among them, we cite solvents like hexane, dichloromethane, ethyl acetate, water, ethanol, acetic acid and acetone, to name just a few more commonly used.

The method of extraction through solvent, or simply extraction, is of far greater complexity than distillation. In those processes, the first step is to isolate the desired substances from the rest of the structural components of plants, such as proteins, lipids and sugars, and other undesired components, which normally coexist in plants. Even with the specificity of the solvents chosen for the target substances, further purification is still required - a fractionation procedure is usually performed. In the end, we compare the extract with a predetermined standard.

Many variables must be considered in the extraction process. The most important related to the target-substances are the polarity, the effect of pH and thermostability. With these parameters in mind, we can select the most suitable solvent for extraction. In the case of solvents, in addition to polarity (equivalent to target-substances), we analyze their flammability, volatility, toxicity and reactivity (with the target-substance).

Many of the pharmacological properties that will be addressed later in this book depend on whether the extract has been obtained from a specific solvent which, after extraction, should be removed (i.e., recycled). However, one of the main nutrients of the Pitanga Cherry, the carotenoids, which confer antioxidant properties and are precursors of vitamin A, are hydrocarbons, reasonably soluble in vegetable oils. In this case, the contact of fruit with edible vegetable oils such as olive oil and others, allows the extraction of this group of substances without



the need or complexity of evaporation of the solvent. Since the carotenoids are also pigments that lend the orange and red colors, vegetable oils in contact with the fruit also acquire a reddish color. The longer the time of contact with the oil of the fruit, the stronger the color, which also means that the oil became richer in carotenoids. Once the oil is impregnated with carotenes, is no longer possible to separate them.

Bibliography of Chapter 1

ABREU, N. A. A.; MENDONÇA, V. et al. Growth of seedlings of Pitanga Cherry (*Eugenia uniflora L.*) in substrates of plain superphosphate. Agrotech. Scienc., Lavras, v. 29, n. 6, p. 1117-1124, Nov./Dec., 2005.

AURICCHIO, M. T; BACCHI, E. M. Leaves of *Eugenia uniflora L*. (Pitanga Cherry): a review. In: *Inst. Adolfo Lutz magazine*, 62 (1): 55-61, 2003.

GROSSMAN, L.; ZITUNE, G.; JANUÁRIO, S. *Essential oils in cooking, cosmetics and health.* São Paulo: Optionline, 2005.

GUENTHER, E. The Essential Oils. Krieger Publishing CO, 1948.

HOUGHTON, P. J., Raman, A. Laboratory Handbook for the Fractionation of Natural Extracts, Chapman & Hall 1998.

LIRA JR., José Severino de [et al.]. *Pitanga Cherry tree*. Recife: Pernambuco Research Company, 2007.

LORENZI, H. et al. Cultivated Exotic Brazilian fruit. Instituto Plantarum (2006) p. 214.

SILVA, S. M. Pitanga Cherry. In: *Brazilian Journal of Horticultural Science*, v. 28, n. 1, p. 159.







Chapter 2 Pitanga Cherry Health



The use of Pitanga Cherry in the treatment of some diseases has been reported for centuries. Various folk uses are known such as stimulating, exciting, antigout, antirheumatic. Cherry is very popular in fighting childhood fevers, gastrointestinal and rheumatic pains.

Our proposal in this book is to show what science has proven so far, leaving an open possibility for the future development of herbal medicines based on this cherry. Anyway, the Pitanga Cherry is listed in the Brazilian Pharmacopoeia, indicating that its use as medicine is safe and officially recognized.

The first scientific studies sought to identify the composition of essential oil of Pitanga Cherry and correlate it with antimicrobial activity. The latest studies have broadened our focus by checking the inhibitory action on xanthine oxidase (antigout), its anti-inflammatory effect, reduction of intestinal propulsion and to lower levels of blood pressure. More recent studies also showed a decrease in the activity of the enzyme alpha-glucosidase, maltase and sucrase, displaying great potential in the treatment of diabetes.

It is important to note that we will not have all these pharmacological benefits

in our bodies by simply drinking small doses of Pitanga Cherry juice, eating the cherry jam or using a Pitanga Cherry perfume or cosmetic.

The concentration of the active ingredient used is a first and important consideration. Usually, it is possible to demonstrate the pharmacological effects only after the application of high doses of the active substance, which must be administered in a specific way, in general, orally. The use of the mentioned active substances orally (such as the intake of capsules) or topical (such as the application of creams on the skin) results in bioavailability and the final results are quite different on the body and vary from person to person.



Functional food: The Importance of carotenoids In human health

Some foods contain several bioactive compounds that can substantially assist in preventing many diseases. We call these foods "functional." There are several groups of identified functional foods and food ingredients, and among them we can give special attention to foods which are rich in carotenoids.

Retinoids, or generally Vitamin A, are called carotenoids in the vegetable world. Many carotenoids are considered pro-vitamin A, since, after absorption by the body, they are converted into vitamin A.

The Pitanga Cherry, pequi (caryocar brasiliense or souari nut), guava and camucamu (myrciaria dúbia), all Brazilian plants, are among the fruits with highest contents of carotenoids in nature. Despite being rich in carotenoids, which confer a pigmentation ranging from yellow to dark red, they also show variation among themselves in types and quantities of existing carotenoids. For example, while the camu-camu is extremely rich in lutein, pequi is rich in violaxanthin and the Pitanga Cherry in lycopene. Other carotenoid rich plants, such as carrot, have beta-carotene as their main component. Although we call carotenoids all these molecules, the differences between one substance and another involve different features and benefits for our bodies.

Carotenoid substances have been mentioned in scientific papers, as responsible for several health benefits: from the increase of immunological resistance to risk reduction in more than 40 diseases, among them degenerative diseases such as cancer and cardiovascular diseases, diabetes, Alzheimer's disease and chronic inflammations. Carotenoids also play an important role in regulating cell growth, and present extensive benefits to the skin, such as anti-aging and antiacne activity - the latter detailed below in the chapter about Beauty. The beneficial action of carotenoids has been attributed to its potent antioxidant activity, especially because of its high reactivity to free radicals (peroxides) and singlet oxygen, helping neutralize them.

Lycopene, the main carotenoid in the Pitanga Cherry is, among carotenoids, the one with the highest efficiency in the capture of singlet oxygen (antioxidant activity). This has drawn much attention from researchers in recent years, especially in studies to prevent prostate cancer, which show that lycopene protects lipid



molecules, low-density lipoproteins, proteins and DNA against attacks by free radicals, thus playing a key role in the protection against several ailments. Several studies have shown that ingestion of carotenoids reduced by up to 32% the risk of lung cancer in nonsmokers. The consumption of lycopene is also inversely associated with risk of myocardial infarction.

The ideal is to eat foods with high amounts of lycopene that can provide about 35 μ g of lycopene per day. Other important sources of lycopene in Brazil are the tomato, papaya and watermelon. The Pitanga Cherry, however, is the fruit with the highest content of lycopene per weight and still contains high concentrations of other carotenoid pigments. While the tomato has on average 30 μ g of lycopene per kg of fruit, the Pitanga Cherry has an average of 70 μ g of lycopene per kg of fruit, of a total of about 1 mg of carotenoids available per kg. It is noteworthy that fruit juice processing does not always ensure the integrity of the content of carotenoids (see box on page 40). It is also important to remember that ripe cherries bring in twice as much lycopene as the partially ripe fruit.



Does the frozen pulp preserve the qualities of the Pitanga Cherry?

When ripe, Brazilian cherries are easily vulnerable to degradation, suffering fermentation very quickly. This makes it very difficult to transport and market the fruit over long distances. The situation is aggravated because most of the producing states are in the Northeast of Brazil and consumers are all over the world.

Besides the possibility to produce essential oils from the leaves and extracts from the fruit, which helps store and reuse bioactive ingredients from plants, the most popular procedure is still the production of frozen fruit pulp. Notably, carotenoids outside their native environment (living cells of vegetables), undergo a degrading process due to oxidation. Normally a rapid process of fruit processing (pulping) and subsequent freezing preserve the contents of carotenoids in different foods.

The main question is: what amount of carotenoids in Pitanga Cherry can we preserve by freezing the pulp and for how long?

Fortunately, several surveys have been conducted in Brazil showing that, despite quantitative losses of about 15% of carotenoids in the production of frozen pulp and a small sensory loss, there are no major negative effects on other nutritional aspects of the fruit. Therefore, it is important to consume the pulp within 90 days, at a temperature of -18°C and protected from light and contact with oxygen - conditions normally found in household refrigerators if the pulp is properly packed.

Another process that allows the conservation of fruit for a long time is the simple freezing of the fruit without prior pulping, in which case thawing must be done immediately before consumption. We have used this method without significant losses in fruit quality.







The wealth of the essential oil from Pitanga Cherry leaves

Early studies on the Pitanga Cherry focused on identifying the composition of its essential oil as well as its antimicrobial action, and the result of several works generated a consensus in the academic community that the production of these substances by the plant has a defensive role. If we take an evolutionary view, plants today are descendants of individuals that existed hundreds of thousands of years ago, managing to survive and multiply despite adversities. Plants that are here today are witnesses that something their ancestors produced assured their future survival. In general, tools of defense are part of the secondary metabolism of plants - that is not directly related to life processes but that still has great importance. An example of these processes is the production of plant essential oils. If through the generations, the plant has spent substantial energy producing those substances, it is likely they are of great importance. In the case of essential oils from the leaves of Pitanga Cherry, we infer that their primary function is to combat micro-organisms.

Several scientific studies conducted in Brazil and abroad have in fact shown this essential oil presents good activity against microorganisms. Antiseptic activity against the microorganisms *Proteus vulgaris, Pseudomonas aeruginosa,* Klebsiella pneumoniae, Candida albicans and Trichophyton mentagrophytes was detected in tests in vitro (laboratory). Other studies showed moderate activity against *Staphylococcus aureus*, and the bacteria more susceptible to the extract obtained from the leaves of Pitanga Cherry, besides *S. aureus*, were *Salmonella cholerasuis* and *Pseudomonas aeruginosa*. All micro-organisms have great implications on human health. The studies showed that the essential oil of Pitanga Cherry inhibited the growth of these micro-organisms with low MIC (Minimum Inhibitory Concentration). The level of MIC is the commonly used way to measure the power of an active ingredient. Basically, it represents the smallest amount of active ingredient that allows the inhibition of the growth of micro-organisms - **the lower the MIC**, **is the more potent the active ingredient**.

When dealing with volatile oils, which are small terpenic molecules with only one functional group, in general there is good correlation between chemical structure and pharmacological function. Normally, alcohols have intense antiseptic action. Aldehydes have antiviral and sedating action. Phenols are extremely irritating and are strongly antiseptic. Oxides are stimulating. Non-polar sesquiterpenes present in the essential oil of Pitanga Cherry indicate a possible anti-irritant activity. This assumption has been proved by us in the experiment conducted with researchers at Unicamp (University of Campinas, São Paulo), in which an edema was provoked in guinea pigs using croton oil and the anti-irritant activity of the essential oil of Pitanga Cherry was tested, compared to the drug Dexamethasone - a corticosteroid of average potency, classified as topical anti-inflammatory hormone.

The experiment demonstrated that the essential oil of Pitanga Cherry has statistically the same response in reducing the swelling as dexamethasone. This anti-irritant activity may, in the future, serve as basis for the development of antiinflammatory herbal medicines from the essential oil of Pitanga Cherry.

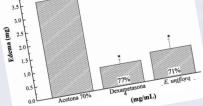
The following table summarizes the scientific experiment conducted at Unicamp: acetone, used only as a control substance, did not inhibit the edema, dexamethasone and the essential oil of Pitanga Cherry equally reduced its occurrence. We used the same amounts of 20 uL/ear in each guinea pig.











4.5 4.0

Future possibilities: The threshold of pharmacological research with active substances of the Pitanga Cherry

Hypothermic and antinociceptive actions

A recent research conducted at the Universidade Federal Rural do Rio de Janeiro (Federal Rural University of Rio de Janeiro), showed that the essential oil from the leaves of Pitanga Cherry inhibited the abdominal constrictions caused by acetic acid and helped increase the resistance to pain (analgesia) in guinea pigs when the essential oil was administered orally at a dosage of 200 and 100mg/kg, respectively.

Anti-diarrheal activity

The effects of the ingestion of an infusion of Pitanga Cherry leaves on the transport of water from the gut and gastrointestinal propulsion were studied at the Federal University of Santa Maria. The experiment was conducted on mice, and the results showed significant reduction in gastrointestinal propulsion and increased water absorption, credited to the presence of tannins and flavonoids such as quercetin - resulting in anti-diarrheal activity, which is supported by popular tradition.

Antioxidant effect of flavonoids

The effect of the flavonoids quercetin and myricetin on the Pitanga Cherry leaves was discovered in 1995. The fruits of Pitanga Cherry, as well as other colorful fruits of the family myrtaceae are also very rich in flavonoids. These chemicals present various pharmacological uses and, remarkably, a powerful antioxidant action, as in the case of carotenoids. Several scientific studies show an inverse relationship between the intake of flavonoids and the risk of cardiovascular disease, chronic



inflammation and certain cancers such as lung and stomach, and deem flavonoids even more potent antioxidants than vitamins C and E. Flavonoids from Pitanga Cherry were able to inhibit 50% of the activity of the enzyme xanthine oxidase, which can potentially result in a significant antigout effect.

Other phenolic compounds have been investigated by several authors and eugeniflorinas D1 and D2 were identified as responsible for antidiabetic action.

More recently the antihypertensive effect of Pitanga Cherry leaf extract was discovered, through intraperitoneal application in mice. However it does not allow us to conclude that we will obtain the same effect in humans through oral administration (tea intake).

Antitumor activity of the essential oil

Some studies carried outside Brazil showed the cytotoxic activity of the essential oil of Pitanga Cherry - and also some of its main components in isolation - against human tumor cells. One of these trials showed effectiveness against prostate cancer cells and completely inhibited the growth of breast cancer tumor cells in vitro (in laboratory conditions). In collaboration with researchers from Unicamp, we conducted further tests that suggest the activity of essential oil against breast cancer cells. It is important to note that these studies are still preliminary. It will be necessary to repeat these tests on animals and later on humans to, in fact, prove its effectiveness.



Infusion or decoction how to make Pitanga Cherry tea

From the publication of the Anvisa Resolution 267/2005, Pitanga Cherry tea was approved by 267/2005, Pitanga Cherry teaves approved by 267/2005, Pitanga Cherry teaves are infusion and substances from cherry leaves are infusion and decoction. There is scientific evidence of the benefits from both methods, but focused on benefits from both methods, but focused on different results. Learn the differences:

different results. Learn the table In the case of infusion, the extraction is done by keeping the plant material in freshly boiled water in a covered container for some time. To make an infusion, add chopped fresh leaves (8and let it sit for 5 to 10 minutes until it reaches a and let it sit for 5 to 10 minutes until it reaches a temperature suitable for drinking. This method is the most recommended to extract essential oils and provide anti-inflammatory, analgesic, d leavels of blood sugar effects.

increase in vision of blood sugar effects. In decoction, the active substance remains for longer at high temperature until its extraction. Place the chopped leaves in cold water and bring to a boil. Boiling time may vary from 10 to 20 minutes. Let it sit from 10 to 15 minutes and strain right away.Many active substances of pitanga Cherry degrade in prolonged heating. This is the preferred method for extracting tannins responsible for the decrease of intestinal movements.



Induction of phytoalexins: the altruistic Pitanga Cherry

Phytoalexins are chemicals produced by plants in response to physical, chemical or biological stress, being able, for example, to prevent or reduce the activity of pathogens. Over 300 phytoalexins have been identified in the vegetal kingdom. In general, we may say that phytoalexins are substances that are part of the plant self-defense cocktail. Plants that possess a rich arsenal for its self-defense logically require less amounts of pesticides for protection.

People are increasingly looking for healthier foods with lower levels of pesticide residues. This has encouraged various agricultural systems that seek to lessen or even prevent the application of chemicals – such is the case, for instance, of organic agriculture and other alternative methods. Invariably, these methods call for greater integration of cultivated plants with the environment that surrounds them, in order to rely less on external substances. When it is necessary to use tools to promote the protection of crops against pests and diseases, we try to get them from other biological sources, such as biological control using insects and beneficial microorganisms as well as the induction of plants to higher resistance.

The issue is not limited to ecological or health related arguments. It is clear that the extensive use of narrow spectrum synthetic antibiotics and antifungal drugs over many years selected strains of phytopathogens resistant to many of these chemicals.





The essential oil of Pitanga Cherry demonstrated, in recent research conducted in two Brazilian southern states, an unprecedented effect, which is the ability to stimulate the production of phytoalexins by other plants. It means the essential oil of Pitanga Cherry acts "altruistically" for some other plants. The essential oil of cherry has already by itself an important antimicrobial activity for being broad-spectrum, prevent the growth of micro-organisms, and in some cases, eliminate certain pathogens. Essential oils and extracts from plants such as oregano, marjoram, lemon grass, eucalyptus and basil also showed this type of effect, and all were effective in inducing phytoalexin in soybean, bean and seeds of various cereals. The essential oil of Pitanga Cherry, in particular, was the most efficient among the medicinal plants tested in an experiment conducted at the Federal University of Santa Maria to stimulate the production of glyceolin, a brown pigment associated with the production of phytoalexins in soybean.



Pitanga Cherry Sentinel: helping the people of the big cities

If the many identified medicinal properties of Pitanga Cherry were not enough, there are always new surprises. Biomonitoring is the science which studies the effects of the quality of air, or rather, the poor quality of air and its effects on living beings. Due to their huge fleet of vehicles, large cities such as São Paulo dump tons of pollutants into the air daily.

Many plants have been used as bioindicators of air quality, especially in developed countries. In these countries, the plants used in biomonitoring are usually native to these regions or represent economic value. In Brazil, these studies began recently with plants such as guava and Pitanga Cherry, both native. The Pitanga Cherry, being particularly sensitive to the effects of pollutants emitted by humans, eventually became an ideal plant for the conduction of these studies on the impacts of pollution on the environment. It is important to say that the Pitanga Cherry tree, in contact with large amounts of pollutants, clearly displays smaller, thinner leaves but with higher number of stomata (which are the cells responsible for gas exchange in plants). These are parameters which, comparatively, can measure the damage caused by poor air quality in large cities.

Moreover, it is always worth keeping in mind that the Pitanga Cherry is an excellent plant when it comes to landscaping. Because it is ornamental, slow growing, with a dense and compact crown and of medium size, the Pitanga Cherry tree is recommended for urban landscaping.



Bibliography of Chapter 2

ALMEIDA, C. E. et al. Analysis of antidiarrhoiec effect of plants used in popular medicine. In: *Revista de Saúde Pública* 29 (6), 428-33, 1995.

AMORIM, A. C. et. al. Antinociceptive and hypothermic evaluation of the leaf essential oil and isolated terpenoids from *Eugenia uniflora L.* In: *Phytomedicine*, vol 16, issue 10, p. 923-928.

AURICCHIO, M. T; BACCHI, E. M. Leaves of *Eugenia uniflora L*. (Pitanga Cherry): a review. In: *Rev. Inst. Adolfo Lutz*, 62 (1): 55-61, 2003.

AURICCHIO, Mariangela T., BUGNO, Adriana; BARROS, Silvia B. M.; BACCHI, Elfriede M. Antimicrobial and Antioxidant Activities and toxicity of *Eugenia uniflora*. In: *Latin American Journal of Pharmacy* 26 (1): 76-81, Jan.-Feb. 2007.

AZEVEDO-MELEIRO, C.H. RODRIGUEZ-AMAYA, D.B. Confirmation of the identity of the carotenoids of tropical fruits by HPLC-DAD and HPLC-MS. In: *Journal of Food Composition and Analysis* 17, 385-396, 2004.

BONALDO, Solange Maria; SCHWAN-ESTRADA, Kátia Regina Freitas; STANGARLIN, Jose Renato; CRUZ, Maria Eugênia Silva; FIORI-TUTIDA, Ana Cristina Grade. Contribution to the study of antifungal and phytoalexins elicitor in sorghum and soybeans by eucalyptus (*Eucalyptus citriodora*). In: *Summa Phytopathol.*, Botucatu, v. 33, n. 4, p. 383-387, 2007.

HOLETZ, Fabiola Barbieri; PESSINI, Greisiele Lorena; SANCHEZ, Neviton Rogerio; CORTEZ, Diogenes Aparicio Garcia; NAKAMURA, Celso Vataru; DIAS FILHO, Benedito Prado. Screening of some plants used in the Brazilian folk medicine for the treatment of infectious diseases. In: *Memórias do Instituto Oswaldo Cruz*, 97 (7), 1027-31, 2002.

LE GALL, G. et al. Characterization and content of flavonoid glycosides in genetically modified tomato fruits. In: J. Agric. Food Chem, 51 (9), 2438-2446, 2003.

LOPES, A. S., MATTIETTO, R. A., MENEZES, H. C. Stability of the Pitanga Cherry pulp under freezing. In: *Ciênc Tecnol. Aliment. Campinas* 25 (3): 553-559, July-set. 2005.

LORENZI, H. et al. Brazilian fruit and exotic crops. Instituto Plantarum, 2006. p. 214.

MAZARO Sergio Miguel; CITADIN, Idemir; GOUVÊA, Alfredo; LUCKMANN, Daiane. Induction of phytoalexins in soybean cotyledons in response to derivatives from leaves of Pitanga Cherry. In: *Ciência Rural*, Santa Maria, v.38, n.7, p.1824-1829, Oct., 2008.

NEUHOUSER, M. L. Flavonoids and Cancer Prevention: What is the Evidence in Humans? In: *Pharmaceutical Biology*, 2004, v. 42 p. 36-45.

OGUNWANDE, I. A. Studies on the essential oils composition, antibacterial and cytotoxicity of *Eugenia uniflora L.* In: *The International Journal of Aromatherapy* (2205) 15, 147-152.

PORCU, O.M. RODRIGUES-AMAYA, D.B. Variation in the Carotenoid Composition of the Lycopene-Rich Brazilian Fruit *Eugenia uniflora L.* In: *Plant Foods Hum Nutr* 63:195-199, 2008.

RODRIGUEZ-AMAYA, DB; KIMURA, M. GODOY, HT; AMAYA-FARFAN, J. Updated Brazilian database on food carotenoids: Factors affecting carotenoid composition. In: *Journal of Food Composition and Analysis* 21, 445-463, 2008.

SHAMI, N.J.I.E. MOREIRA, E.A.M.M. Lycopene as antioxidant agent. In: *Rev. Nutr.*, Campinas, 17 (2) :227-236, abr. / jun., 2004.

SULTANA, B.; ANWAR, F. Flavonols (Kaempeferol quercetin, myricetin) contents of foods selected, vegetables and medicinal plants. In: *Food Chemistry* 108, 879-884, 2008.

STANGARLIN, Jose Renato; SCHWAN-ESTRADA, Kátia Regina Freitas; CRUZ, Maria Eugenia da Silva; NOZAKI, Marcia H. Medicinal plants and alternative control of plant pathogens. In: *Biotecnol. Ciênc DeSENV.*, Brasília, v.2, n.11, p.16-21, Nov.-Dec., 1999.







Chapter 3 Pitanga Cherry Beauty



Anti-aging Pitanga Cherry: richness in carotenoids

Over the years, exposure to ultraviolet (UV) causes more skin damage than we can imagine. The deterioration of the ozone layer that surrounds the planet has become a serious problem for human health. Nothing indicates that the radiation will decrease in the future, in fact, it tends to increase with time, thus causing greater increase in the rate of melanoma and other cutaneous cancers. What is needed for good skin protection may not only be the use of cosmetics with good chemical sunscreens (which we are already used to doing) or using physical sunscreens (with components that only form a "physical" barrier) but rather something that creates photoprotection in the skin and that does not cause rashes. Exposure to UV rays produces oxygen free radicals and other highly reactive molecules and causes peroxidation of lipid membranes that protect the epidermis and dermis, causing skin damage, wrinkles and irritation.

Our bodies have natural mechanisms to protect themselves from the harmful action of free radicals. However, the capacity for self-defense of these systems decreases with age, high levels of stress and decreased immunity of the human body. Our complex defensive system involves the presence of compounds such as enzymes, antioxidants, vitamins and other compounds that act to limit the oxidative reactions.

The skin antioxidant system is essential to protect it from the action of free radicals, because it acts to neutralize them, reducing the effects of aging they would cause if remained in it.

Vitamin A is the generic name of a class of chemicals called hydrocarbons. As already mentioned in the book in the animal world, it is represented by retinol and in the plant world by a class of substances called carotenoids.

Vitamin A and many carotenoids are capable of capturing free oxygen (responsible for "oxidation") and neutralize free radicals.

Retinoids, in addition to being effective agents in the treatment of wrinkles, also help prevent their formation. They are required for normal growth of epithelial cells and also alter the synthesis of collagen in the dermis. The topical application of vitamin A to the skin tends to slow down the changes that occur with aging, giving the skin a younger appearance. That is why the retinoids are present in most 'top



of the line' cosmetics in the market. However, the use of retinol also comes with a price: adverse effects such as telangiectasia ("spider veins on the face"), which are common after prolonged use of these products – that is why we should be careful about the concentration of the product and its continuous use.

Many plants are important sources of carotenoids, such as carrots, tomatoes or the Pitanga Cherry. Carotenoids are precursors of vitamin A, or are converted into vitamin A in the body, taking part in the cutaneous activity. Carotenoids are less irritating to the skin than the retinoid substances themselves and help reduce some of the direct effects of the latter on the skin.

The Pitanga Cherry, according to data from the United States Department of Agriculture, is ranked as the fruit with the highest known levels of carotenoids per weight in nature, containing on average 1500 IU (International Units) per 100 grams, or about 75 mg retinol equivalents per 100 grams of fruit, i.e. around one-seventh of the amount recommended daily intake for adults.

Besides the direct action on the release of free radicals caused by UV rays, a series of direct and indirect cellular processes occurs due to damage in cells and tissues. The cells confuse the harmful stimulation caused by UV rays, like a mechanical breakdown of the skin barrier caused by the action of microorganisms, and release proinflammatory substances initially and then white blood cells, which act in defense of a non-existent microbial invasion, being in fact the action of UV rays. This anti-inflammatory reaction causes the expansion of the inflammatory process, creating a negative vicious cycle, which is called oxidative stress, when the stimulus becomes continuous.



It is mportant to note that the anti-inflammatory reaction of the skin (for later regeneration) is a continuous process as long as there is exposure to UV rays. This reaction can be easily noticed in extreme cases, such as the effects of burning of the skin after long exposure to the sun. Even when these extreme responses are not noticed, the antiinflammatory mechanisms in the skin continue to occur to some extent and its effects accumulate over time. The Pitanga Cherry produces a very

special essential oil in its leaves. This oil, unlike other oils produced in nature, has a unique composition of a class of chemicals called sesquiterpenoids, which scientifically demonstrated a potent antiirritant activity when applied to the skin. This beneficial

activity counterbalances the effects of skin reactions to UV exposure.

Together with CEPAD – Dermatocosmetic Research Center, we have conducted a clinical trial to test the anti-wrinkle activity of a cream formulated with essential oils from leaves and fruit extracts of Pitanga Cherry. Twenty volunteers tested the product for 56 days and underwent clinical evaluations at the beginning, middle and end of treatment. The study concluded that there was statistical evidence in reducing wrinkles and improvement on the overall appearance of the skin in 61% of volunteers after 56 days of treatment. In almost all cases, the improvement found was in fact recognized in the first 28 days, both by doctors and by volunteers.



Challenges in developing cosmetics and the role of the Pitanga Cherry

Some dermatological conditions, called in medicine "dermatosis", are the result of external and internal factors of the human body. The main causes are exposure to UV rays, increasing oiliness by excessive sebum production by the pilosebaceous gland and the presence of bacteria found in the skin itself, which, due to some injury or trauma, can cause erysipelas. Also, a decrease in the body's immunity itself may cause some dermatosis such as seborrheic dermatitis, which can be controlled but not cured.

The aging of the skin, albeit not a disease, is notably accelerated or delayed due to the influence of multiple factors.

Free radicals, responsible for the exacerbation of skin aging, act by damaging the cellular genetic material and increasing the formation of canthal rhytides (wrinkles per se).

A major challenge in developing cosmetic products in order to fight oxidation is to avoid irritation due to, in addition to antioxidant activity, the keratolytic action (removal of the superficial layer of skin), causing irritation - in this case, an induced dermatitis.

In medicine, the effectiveness of vitamin A (retinoids in general) has been recognized since 1930 in some keratinization disorders (excess production of keratin) and in the treatment of wrinkles - long and effective studies have been published since 2004. However, the adverse effect of typical use of retinoids is the fact that many patients develop a rash. The key is to find the active ingredient that accounts for the antiaging activity, but that will not cause irritation.

The need for balance has always been a cosmetic ideal.

Due to its effective action on bacteria and anti-irritant activity of the essential oil from its leaves, along with the antioxidant activity of its fruit, the Pitanga Cherry managed to join these two ends.



Acneic skin and vitamin A

Over 100 years ago, it was found that *Propionibacterium acnes* (formerly known as *Bacillus acnes*) was related to the pathology of acne. Then it was discovered that other micro-organisms, such as *Staphylococcus sp.* and *Malassezia furfur*, were also involved. These three bacteria account for over 99% of the total microflora in the acne condition.

To effectively control acne, antimicrobial therapy with synthetic antibiotics was introduced in its treatment in the 1960s. With use, an important problem was found: the microbial resistance to antibiotics and, therefore, failure in treatment.



How acne develops

1. Skin renews itself all the time: new cells are produced to replace dead cells, which are spewed out. However, one effect of this natural process is that skin pores become congested by dead cells and also with sebum, sometimes stimulated by hormone production.

2. Dead cells mixed with large amounts of sebum at a single point cause what dermatologists call comedones - small lumps on the skin.

Bacteria multiply at that point, which is rich in food (sebum and dead cells), making the conditions conducive to their growth.

4. When multiplying, the bacteria excrete fatty acids that irritate the membranes of skin cells, causing inflammation.

5. The inflammation caused by the bacteria cause an opposite effect - the production of anti-inflammatory agents through the skin, leading to the production of pus. Blood and lymph from nearby areas also become congested, increasing the comedone, in which case the anti-inflammatory process begins with an endless cycle that keeps itself going, because the hormonal stimulation causes the release of even more antibodies and increased sebum production which worsens the reaction. The pores become fiery red, very inflamed and infected, and then turn into large pimples.

6. If the surface of the pore is very narrow and the air does not penetrate – i.e., anaerobic conditions prevail - the pimples have small white heads. If the pores are penetrated by air, the sebum darkens, creating a black mark – or blackhead. If the pore blockage occurs below the skin surface, this point is very sensitive to touch, but no head is visible.

7. With or without help, the area around the pimple tends to be repaired by the body – if the immune system is functioning properly. However, if the immune system is weakened, the inflammatory process could get much worse, requiring medical attention.

8. When we apply antibiotics and other chemicals often, we tend to worsen the process because, after all, the skin usually becomes dry, helping to block the pores more easily. The pimple production process begins again.



The drugs currently in use are topical retinoids and oral antibiotic and keratolytics. The arsenal currently recommended by physicians indicates that the combination of multiple therapies appears to be essential to strike the problem, which is multifaceted.

But we do not always have to deal with advanced levels of acne. In most cases, acne can be controlled in its initial phase, since the level is low, through prophylactic activities and a good diet. Topical treatments with the use of medication should be guided by a specialist.

There is evidence that diet affects a lot on acne, and it becomes essential to begin the treatment there. A balanced diet helps to balance hormone production to maintain the integrity of cell membranes and reduce oxidation caused by free radicals. Recent studies have shown that eating foods rich in vitamins A, E and B1, as well as zinc and magnesium helps to improve acne conditions. Foods that are rich in essential fatty acids such as linoleic acid (precursor of omega-6), and foods containing linolenic acid (precursor of omega-3) help reduce the condition. A clinical study conducted in Belgium showed that a decrease of linoleic acid in sebum may be partly responsible for acne. When doctors applied a linoleic acid supplement topically, there was a 25% reduction in the number of comedones within one month. The ingestion of food containing pro-biotics, i.e., live microorganisms, bacteria of the genus bifidobacterium and lactobacillus are also very helpful in improving acne.

Foods that aid in the treatment of acne	
Vitamin A (carotenoides)	carrots, peppers, Pitanga Cherry
Vitamin E	Wheat germ, grape seed oil, sunflower oil
Zinc	Soybean meal, green onions, arugula, parsley, grape leaf
Magnesium	tamarind, grape leaf, ginger, green onions
Linoleic fatty acid	Passion fruit oil, cod liver oil,primrose oil, corn germ oil
Linolenic fatty acid	Soybean oil and canola oil
Pro-biotics	Fermented Milk rich in pro-biotics – such as <i>Activia®, Yakult</i> ®

The essential oil of Pitanga Cherry aids in the treatment of acne

Initially, we tested, together with researchers at Unicamp - Universidade Estadual de Campinas (Campinas State University – São Paulo), *in vitro* antimicrobial activity (i.e., under laboratory conditions) of essential oil of Pitanga Cherry specifically against the three main micro-organisms that cause acne: *P. acnes, M. furfur*, and *S. epidermis*. The result was encouraging: the essential oil proved to be powerful enough to prevent the growth of the three micro-organisms, even at very low dosages.

The anti-inflammatory activity of essential oil, combined with its ability to specifically target acne micro-organisms, gave us the basis to formulate a cosmetic cream with the goal of helping treat acneic skins - and the cream was tested on several patients with initial to moderate acne conditions. In this experiment, led by CEPAD at the ABC College of Medicine, 20 women between 18 and 55 years-old, representing all skin types, received the formula containing essential oil of Pitanga Cherry and were told to use it for 28 days. The volunteers were evaluated on the first and last days of the experiment.

The result was very encouraging: the study concluded that the formula tested was well accepted by the skin and did not cause sensitivity reactions or skin irritation. After medical evaluation and also through the perception of the volunteers themselves, the formula showed efficacy in reducing acne and the overall appearance of the skin.

In short, the proper protocol to fight acneic skin includes an appropriate diet, with ingestion of low amounts of sugar, rich in essential fatty acids, rich in protein and low in cholesterol. Daily prophylaxis with a facial cleansing tonic, followed by the application of a topical treatment for acneic skin, completes the program.



You can make a cream for acneic skin yourself

1/2 glass of diet Activia® (low sugar) or a little bottle of Yakult®

1 tablespoon soybean meal

1 tablespoon passion fruit oil

1 tablespoon finely grated carrot

20 drops of propolis

20 drops of essential oil of Pitanga Cherry

Mix everything and apply on face, massaging it lightly. Wash after application. Always wash hands thoroughly before applying the cream on clean, dry face. The mixture should be stored in refrigeration for

up to one week.



Pitanga Cherry Facial **Revitalizing Solution**

2 tablespoons Pitanga Cherry pulp

2 tablespoons distilled water

3 teaspoons of Pitanga Cherry leaf

(see Infusion on page 47)

2 tablespoons of alcohol

Mix all the ingredients and shake well before using. The mixture should be stored in the refrigerator and used within a maximum of two weeks.



Bibliography of Chapter 3

BUNSELMEYER, B. Probiotics and prebiotics for the prevention and treatment of atopic eczema. In: *Der Hautartz: Zeitschrift fur Dermatologie, Venerologie und verwandte Gebiete*; 2005, October 21.

DEL ROSSO, J. Q. Combination topical therapy in the treatment of acne. In: *Cutis*. 2006 Aug., 78 (2 Suppl 1):5-12.

EADY, E. A. Propionibacterium acnes resistance: a worldwide problem. In: *Dermatology*. 2003; 206(1): 54-56.

GABRIEL, J. Clear Skin: Organic Action Plan for Acne. iUniverse 2007.

GOODMAN, G. Managing acne vulgaris effectively. In: *Aust Fam Physician*. 2006, Sep. 35(9): 705-709.

LETAWE, C.; BOONE, M.; PIERARD, G. E. Digital image analysis of the effect of topically applied linoleic acid on acne microcomedones. In: *Clin Exp Dermatol.* 1998, Mar; 23(2):56-58.

PECHÉRE, M. et al. Antibacterial activity of topical retinoids: the case of retinaldehyde. In: *Dermatology* 2002; 205, 153-158.

TADINI, K. A. et al. Epidermal effects of tretinoin and isotretinoin: influence of isomerism. In: *Pharmazie* 61, 5, p. 453-456, 2006.

TILL, A. E. The cutaneous microflora of adolescent, persistent and late-onset acne patients does not differ. In: *Br J Dermatol.* 2000, May, 142(5): 885-892.









Chapter 4 Pitanga Cherry Perfume



This chapter is dedicated to aromatherapy and the interrelationship between the essential oil, the Pitanga Cherry hydrosol and feeling well, including the human emotional aspect.

In previous chapters, we described several properties and some of the uses and proven benefits of the Pitanga Cherry essential oil and extract. In this chapter we will describe some of what we know about the cherry hydrosol and its essential oil, both used in aromatherapy, in addition to bringing safe tips on these substances, but not necessarily scientifically proven. That is, here we allow ourselves to enter areas not fully explored by science and based on what we already know, speculate a little about what we do not know.

Let us begin with the hydrosol. In the first chapter, when we explained the process of distillation, we briefly said that the oil was separated from the distillate in the final stage of the process. In general, the essential oil gets all the glory and the hydrosol usually ends up being discarded. But it should not be so. The hydrosol is not the poor cousin of the essential oil. It is not the byproduct of distillation, but a co-product. Basically, we can say that in the process of distillation, we dragged two classes of substances contained in plants: the substances that are soluble in water and the ones which are insoluble. Essential oils are the molecules considered insoluble. The hydrosol is the sum of substances that have been dissolved and that we can no longer be separated from the water. In no way can we say that this group is of less value than the first. Just because of a difficulty in standardizing the hydrosols, their variation in the market is wide. However, when the plant is important, rare or simply too expensive, its hydrosol also becomes very important. Two good examples are rose water and lavender water. In the first case, the essential oil is so expensive - in some cases costing over seven thousand dollars per kilogram - that hydrosol gains ground naturally.

Hydrosol comes from the strange combination of the words "hydro" in Greek - which means water - and "sol" which means soluble. The hydrosol looks milky white immediately after distillation, but over time it tends to become lighter. Although the use of essential oils in aromatherapy dates back in time - we will come back to this later - the use of hydrosol in aromatherapy is very recent.

In the distillation process, we produce something around 200-300 liters of hydrosol for up to 1 kg of essential oil. There is no doubt that the essential oil, *per se*, is much more potent. So why would we make use of the hydrosol? Precisely because it is a safe way to gain access to many components of the Pitanga Cherry



leaf, mainly the ones which are water soluble. Its non-professional application is simpler and less dangerous.

The hydrosol from Pitanga Cherry has a slightly acidic pH, in the range of 4.0, close to the skin's pH, which is around 5.0, and very close to the vaginal pH, around 4.0. This translates into slightly astringent properties, stimulating circulation and promoting a feeling of freshness. The hydrosol from Pitanga Cherry has two other properties, which add to its value: due to its pH and concentration of heavy soluble essential oils, the hydrosol slightly limits microbial growth, helping prophylactis and also in masking unwanted odors, leaving a mild cherry aroma.



A bath scented with Pitanga Cherry hydrosol

Add 30 to 250 ml of Pitanga Cherry hydrosol to a bathtub half full of warm water.

Take an immersion bath. Smell the perfume and feel the freshness offered by the Pitanga Cherry hydrosol.

The Pitanga Cherry hydrosol does not affect pumps in hot tubs.

Aromatherapy is not intended to address only the problems of the body. It is also an excellent way to reach the soul. An old proverb says: "Food feeds the body, but flowers heal the soul." It is known that the olfactory stimulus accesses areas of the brain responsible for memory storage and processing of emotions known as the limbic system. For centuries, the natural essences of plants have been used as perfume and incense, for sexual stimulation, religious rituals, meditation and emotional balance. Essential oils such as Pitanga Cherry's have been extensively used in therapies for memory retrieval, hypnosis, insomnia and other psychosomatic issues, precisely because of their direct connection to the limbic system. It is noteworthy that, in small and subtle quantities, the essential oil can be beneficial for improving the mood and other psychological effects. However, if the olfactory system becomes saturated with the smell, the opposite effect may be caused in the body that will react negatively, creating repulsion.



Does sex begin with scent?

Since the Dutch physician Frederik Ruysch identified a small organ in the nasal cavity called the vomeronasal organ (VNO) in humans in the mideighteenth century, several studies were published showing its interrelationship with the processing of olfactory signals. The purpose of the VNO seems to be only to detect chemical signals - such as pheromones - involved in sexual behavior and marking of territory. Monti-Bloch was one of the scientists who were able to measure the electrical activity in VNOs after specific chemical stimulus.

Some aromatic compounds did not cause any response, while others - for example, aromas extracted from skin sweat activated the VNO. Later, the active ingredient of male skin sweat, called androstadienone, was isolated. This substance, when applied to stimulate female VNOs provoked signs of relaxation, lower heart rate and an increase in body temperature. It is believed that this substance is part of the group of human pheromones.

The term "pheromone", which comes from the Greek *pherein*, meaning transfer, and *hormon*, to encourage, was coined by Peter Karlson and Martin Luscher in 1959, soon after the identification of the compound *bombykol*, a substance emitted by the female silkworm to attract males of the same species. In animals, pheromones indicate the availability of females for mating. Many Lepidoptera family – of the butterflies and moths – can identify females at distances up to 10 km from pheromones emitted in very small doses of the order of 10⁻⁹ mg. Pheromones are distinguished from hormones; whereas the latter are released internally and exert influence on the metabolism of the individual, pheromones are released externally, acting on individuals of the same species.

Essential oils released by the flowers also act similarly to pheromones. Certain flowers release intense aromas at night, but do not release anything during the day. The flowers of *Nicotiana alata*, which release fragrance only at night, attract only a particular type of moth. The flowers of *Lantana camara* attract only one type of butterfly. The purpose of plants is, with their shapes and colors, to attract animal pollinators to ensure the preservation of the species. The flowers from Pitanga Cherry attract bees. It is noteworthy that the insects probably get sexually aroused and are confused by the scent of flowers. Therefore, it is not a pheromone, which



by definition attracts the other gender of the same species, but it is still a kind of hormonal stimulation.

There is no consensus in the scientific world as to whether human pheromones really exist. However, the evidence that they may exist gained strength when Martha McClintock, a renowned psychologist at the University of Chicago, published an article in 1998 showing that women respond to hormonal activity of other women. She took samples of sweat from the armpits of women who had not ovulated in a given month and sprayed it on the upper lip of other volunteers. This accelerated the onset of LH, the luteinizing hormone, which triggers the process of ovulation and, in turn, reduced the menstrual cycle in those women up to two weeks. McClintock also found that when the sweat donor had ovulated that month, the stimulus of others with their sweat delayed their menstrual cycle for up to 12 days. In men, LH stimulates testosterone production. Further research may explain why men tend to consider women in the middle of the menstrual cycle - the most fertile period more attractive than at other times of the month.

In 2000, neurogeneticists at the Universities of Yale and Rockefeller announced the discovery of the first gene linked to pheromones. This gene, identified as V1RL1 determines the production of a receptor to which the pheromone molecule connects when it is absorbed by the nasal mucosa.

Another study carried out by Martha McClintock and Suma Jacob has shown that after exposure to androstadienone and estratetraenol, both physical and psychological aspects of volunteers were changed. Both caused immediate short spans of good mood in women, but irritability in men. In the late 1990s, Carole Ober of the University of Chicago, concluded that women tend to choose partners with a

3 PITANGA

genetic basis different from theirs. Claus Wedekind of the University of Lausanne, Switzerland, made a similar experiment with sweaty T-shirts. He asked 49 women to sniff T-shirts that had been worn by unidentified men, in the probable period of ovulation – and therefore at the height of their sense of smell – and then asked them to rate the shirts with the best and worst odor. He found that each woman preferred the smell of the shirt worn by the man who possessed the genotype that differed the most from hers, perhaps associated with an immune system equipped with something she did not have, thus increasing the likelihood of their children having a stronger immune system.

Rachel Herz, a researcher of the effects of odors on human behavior, Brown University, asked 166 women what they considered to make a man attractive enough to have sex with. The women replied that the appearance, voice and touch sensation on the skin counted, but the odor was described as the most important factor, especially when they decided who they would definitely not have relations with.

The preferences of the human sense of smell are naturally complicated. Researchers at Monell, an important center for research and treatment of diseases related to smell found that bad odors caused as much stimuli as good smells. Some people find the odor of animal feces and even that of decomposing carcasses stimulating. It is noticeable that almost all the perfumes of success of the twentieth century, including Chanel No. 5, were designed with animal notes, such as the ones extracted from the civet or ambergris from whales, present in the composition of the "musk" note. These notes have definitely nasty smells. Civet cats, felines which are virtually extinct, have been exploited for decades because of their hormoneproducing gland. Today, there are synthetic mechanisms for the production of Civeton, so that the pressure on the species has virtually disappeared. Besides its



aphrodisiac aspect, musk acts as a potent fixative in perfumes. Ambergris, another compound considered aphrodisiac and used since ancient times by the Chinese - and all the Western civilization - is a secretion produced by only one species of whale, apparently as part of their digestive process. As with the civet, nowadays there are alternatives to the ambergris aroma - and many perfumes today continue to use its synthetic countertype in their composition.

Steroids and sterols responsible for the reproductive mechanism and sexual arousal in humans are small lipophilic organic compounds, causing them to have easy absorption by cell membranes and quickly enter the cytoplasm of target cells. This is why they also have a lot of affinity with the nervous system. The chemical similarity with many of the aromatic terpenes present in essential oils produced by plants is intriguing. Its structural formula, molecular weight and functional groups are very similar to the sesquiterpenes and simple diterpenes, alcoholic and phenolic, produced by plants. Moreover, the basic unit of the synthesis of vegetal terpenes, which in turn are reflected in the essential oils, is a molecule of isoprene - the same unit of the synthesis of vegetal phytosteroid and phytosterols. Can the olfactory stimulus from some components of essential oils be confused with sex steroids and sterols and cause similar effects in humans? Apparently, we have some evidence that this is possible.

Take for example the case of the essential oil of ginger (*Zingiber officinale*): among the various components of ginger, we can find several sesquiterpenes that Pierre Franchomme and other researchers identified as sexual tonics and aphrodisiac agents. They also demonstrated the "estrogenic" effect of the essential oil of *Salvia Sclarea* affecting the menstrual cycle and acting as an aphrodisiac. The essential oil of blue chamomile (*Matricaria recutita*), because of chamazulene, showed similar results. As for the essential oil and hydrosol of Pitanga Cherry, although there is



no scientific evidence available, several people have reported a feeling of wellness, and in some cases, aphrodisiac stimulation.

Research carried out by Robert Henkin, Center for Sensory Disorders, Georgetown University, says that a quarter of the people with olfactory dysfunction reported that they had lost sexual desire. Anosmia is what scientists call the loss of olfactory sense, such as blindness and deafness are for sight and hearing, respectively. The olfactory dysfunction may occur due to exposure to toxic substances, treatment with medications, allergies, genetic factors or natural aging. With anosmia, apparently also comes the loss of memory and sexual desire. The olfactory stimulus is part of the limbic system, the same system that is present in all animals and is responsible for the processing of emotions, memory, sexual arousal and reproductive aspects. Apparently, all the stimuli processed in the limbic system are very much interrelated.

Sexual function in humans is certainly a very complex process. It probably involves both verbal and nonverbal communication. The creation and use of fragrances that sexually stimulate individuals is obviously part of nonverbal communication. Perhaps it is just a secondary aspect in humans, but it is very present and processed in irrational order. The science of fragrances and their effects on humans moves at a fast pace. Little is known about the mechanisms of operation and the reasons fragrances and aromas cause attraction and sexual arousal in humans, but it is a fact that this industry involves billions of dollars annually on perfumes, toiletries and cosmetics. It is practically impossible to think of these products devoid of smell. It is undeniable that much of the appeal of perfumes is directly related to the attractiveness to the opposite sex, even if it is part of our subconsciousness. But the best is that we do not need to believe that it works to achieve our goals. As the old adage goes: I do not believe in witches, but they surely do exist.



Using a diffusor

There are various types of diffusors - from the simplest, made of ceramic, hot run, to the most sophisticated made of glass, which are run cold. The first, popularly known as candle essential oil diffusors, allow you to put two or three drops of essential oil in a small bowl standing over a candle below, which provides heat for the slow volatilization of the essential oil.

More modern diffusors, so-called cold, allow the placement of the oil in a glass bowl which receives a continuous flow of air, such as a fish tank pump. This flow provides controlled volatilization without damaging the oils through heat. This is particularly relevant when the oils are floral, and particularly expensive.

Important: Always mix essential oil in water to diffuse the aroma. While there is no mixing between water and oil, water is essential to facilitate the volatilization of the

Aromatize the environment for 15 to 60

Bibliography of Chapter 4

ACKERMAN D. A natural history of the senses. Vintage Books, 1990, p. 11-63.

CATTY, Suzanne. Hydrosols: the next aromatherapy. Healing Arts press, 2001.

GLASER, G. The Nose. Atria Books, 2002. p. 113-126.

GROSSMAN, L. *Essential oils in cooking, cosmetics and health*. São Paulo, Optionline Publ., 2005.

That smacks of Alzheirmer's. In: Revista Veja, July/25/2007.

Memories in fragrant dreams. In: Scientific American Brazil (62), Year 6, p. 19.

SCHNAUBELT, K. Advanced Aromatherapy. Healing Arts Press, 1995.

SLATER, L. The chemistry of love. In: National Geographic Brazil, in February 2006.

ZOGHBI, M. G. B. ANDRADE, E. H. A., MAIA, J. G. S. Aroma of flowers in the Amazon. *Goeldi Museum*, 2001, p. 19.









Chapter 5 Pitanga Chery Flavor

Tropical Cognac

"(...) From the drinks which at present are most characteristic of the Northeast of Brazil the most noteworthy are (...) the Apipucos style Pitanga Cherry: rum with cachaça (brandy) in an almost tropical state, a drink which also takes a liquor, made from violet or rose, prepared by the nuns of Garanhuns, and cinnamon reduced to powder by Georgina Tasso from Apipucos. That cognac counts among famous enthusiasts of its truly complex taste and, in the Spanish sense of the word added to Portuguese, exquisite: President Costa e Silva, filmmaker Roberto Rossellini, novelist John dos Passos, politicians Jânio Quadros and Carlos Lacerda (...) among several others."

Gilberto Freyre in "Açúcar" Companhia das Letras Publisher, 1997 (first edition - 1930).

"In this vegetation the Pitanga Cherry tree prevails (...) whose fruit, yellowish red, and a somewhat acrid taste, but very nice, was just riping. We find large groups of women and children who were pleased to go picking these fruits (...). The encounter was very convenient to us, because in that scorching heat, we ate the Brazilian cherries the women were selling at low prices with great pleasure."

Jacques Johan von Tschudi in "Viagem às Províncias do Rio de Janeiro e São Paulo", (Journey to the Provinces of Rio de Janeiro and São Paulo), 1857.



The Pitanga Cherry is so tasty, such a different fruit and so favored by so many, it is best not to describe its virtues in theoretical texts, but rather through recipes. In the following pages we present some selected recipes, all taking back to the various dimensions of this wonderful fruit's intricate flavor. This you will only know if you try them yourself.







Basic Pitanga Cherry sauce

- 500 g Pitanga Cherry pulp
- Salt to taste
- 1/2 tbsp sugar
- 1 pinch black pepper
- 1 pinch oregano
- 1 tbsp tomato paste

Bring to a boil and simmer thoroughly and the sauce is ready for any savory dish.

Pitanga Cherry dressing

- 1 squeezed lime
- a little salt
- 1 tbsp balsamic vinegar
- 1 ladle basic Pitanga Cherry sauce
- 1 onion, minced
- 1 sprig of parsley
- green onions, chopped
- 4 tbsp extra virgin olive oil

If you want a less caloric sauce, replace the olive oil with 4 tablespoons of nonfat yogurt.





Marinated salmon salad with Pitanga Cherry sauce and almonds

- 200 g marinated salmon with dill
- 2 tbsp basic Pitanga Cherry sauce
- juice of half a lime
- extra virgin olive oil
- a pinch of salt
- 50 g toasted flaked almonds

Serve with various types of toast.





Hearts-of-palm salad with smoked salmon and Pitanga Cherry sauce

- 300 g shredded hearts of palm
- 150 g sliced smoked salmon
- 2 tbsp extra virgin olive oil
- a pinch of salt
- juice of half a lime
- 80 ml basic Pitanga Cherry sauce
- 1 tbsp worcestershire
- chopped parsley to taste

Arrange the hearts of palm in the center of a plate and place salmon rolls around them. Finally spread the Pitanga Cherry sauce with the other ingredients.





Tricolor salad with raspberry and Pitanga Cherry sauce

- 1 red pepper cut into thin strips
- 1 yellow pepper cut into thin strips
- 1 green pepper cut into thin strips
- 1 heart of palm cut into thin strips
- 1 small box of raspberries
- lime juice
- salt to taste
- black pepper
- chopped parsley
- chopped celery
- 1 cup basic Pitanga Cherry sauce
- 1 tbsp balsamic vinegar

Mix everything and arrange on a platter.





Smoked haddock salad with dry curd and Pitanga Cherry sauce

- 200 g smoked haddock, cut into thin slices
- 2 tbsp olive oil
- juice of half a lime
- 1 pinch of salt
- 1 pinch of spicy paprika
- 1 sprig of thyme
- 1 bunch chopped green onions
- 2 tbsp Pitanga Cherry sauce
- 6 balls of dry curd
- 1/2 tbsp Zaatar

Place the haddock slices in a dish and spread the dry curd over them. Then mix all the dressing ingredients and pour it on top.





Gnocchi carotene with Pitanga Cherry sauce

Pasta

- 2 boiled potatoes
- 3 cooked carrots
- 1/2 tbsp salt
- 1/2 tbsp pepper, white realm
- 1/2 tbsp butter or margarine
- 1 egg
- wheat flour
- Pitanga Cherry sauce with a pinch of oregano and a sprig of basil

The vegetables should be thoroughly cooked and mashed before you add the other ingredients. The flour should be added as necessary to make a soft dough. Let it sit for 30 minutes. After that, chop the dough into gnocchi shape and cook it in a saucepan in enough hot water with a little oil and salt. Let it simmer. The pieces will be cooked when they float.

Place on a platter, pour the sauce on top and sprinkle grated Parmesan cheese.





Black rice risotto with Pitanga Cherry sauce and mint

- 1 small onion
- 3 garlic cloves
- oil
- 2 cups black rice
- 1 tablet of vegetable or chicken broth
- Pitanga Cherry sauce

In a pressure cooker, sizzle the onion and crushed garlic in a little oil until they are golden brown. Add the rice to the seasoning, adding the vegetable or chicken broth. Cook in pressure for 20 minutes. Open the pot to make sure the rice is *al dente* and add a ladle of the cherry sauce. Let it cook without pressure until the water evaporates.

Serve in a soup bowl pouring more of the cherry sauce over and sprinkle with mint leaves.





Portuguese sausage with sauerkraut cooked chicken with Pitanga Cherry sauce The sweet potato provencal is a side dish

- 1 small finely chopped cabbage
- 1 medium onion, grated
- 4 cloves garlic, crushed
- 1 pinch of salt
- 1 pinch of black pepper
- chopped green olives
- 2 tomatoes, peeled and seeded, chopped
- 4 sweet potatoes cooked in water and salt
- chopped parsley
- 1 cube of vegetable broth
- 1/2 kg chicken breast sausage
- 1 cup basic Pitanga Cherry sauce

Place the onion and garlic in a pan and fry, then add the tomatoes, salt, olives and pepper. Add the cabbage and cook well, and set aside.

Boil the sausages in water and salt until they are cooked. Drain the water and place the sausages to cook in the basic cherry sauce for 10 minutes, with half a cube of broth. Remove the sausages and set aside.

In a skillet, fry the rest of the broth with chopped parsley and add the cooked sweet potatoes.

Arrange everything on a single platter and serve hot.





Chicken rolls with Pitanga Cherry sauce and baby carrots

• 4 large thinly cut chicken steaks

Season the fillets with anatto coloring, salt, pepper and garlic. Open up each fillet on a board and fill with chopped onion, olives, carrots and boiled eggs. Make rolls with the fillets using a very thick thread to keep them in shape. Brown them in a frying pan with oil, rolling them to brown all sides until well cooked.

In a skillet, fry some garlic with parsley and add the baby carrots until they are cooked.

Serve the rolls sliced with the carrots and a little Pitanga Cherry sauce.





Duck breast with Pitanga Cherry sauce, Morocco couscous and asparagus

- 200 g duck breast
- 1/2 cup red or white wine
- salt
- ½ tbsp oregano
- 1 onion, chopped
- 4 garlic cloves
- ½ tbsp sweet paprika
- ½ tbsp black pepper
- 1 bay leaf
- 1 cup orange juice
- 1/2 cup water
- chopped green onions
- 3 leaves of sage
- 2 tbsp oil
- 6-8 large green asparagus cooked and buttered
- 4 tbsp basic Pitanga Cherry sauce

Mix everything, place in a container with a lid and chill for two hours.

Then put it in a baking pan covered with foil and roast both sides for as long as needed to cook. When it is very soft, remove the foil and let it brown.

Make a cup and a half of couscous with chicken broth and Syrian pepper and set aside. Cook the asparagus in salt and a pinch of baking soda. Once cooked, sizzle lightly in a pan with garlic and parsley.

Couscous

In a saucepan fry an onion and 3 crushed garlic cloves in a little oil, then throw the couscous and saute well. In a large mug, dissolve a cube of chicken broth with 1/2 liter of water and then slowly add the broth to the couscous, stirring constantly until you use all the broth.

In a white platter, place the duck breast in the center, pour the cherry sauce around and, on each side, place the couscous and asparagus. Garnish with chopped parsley.





Grilled whiting with Pitanga Cherry sauce, red onion and beetroot

Fish

- 4 fillets of whiting
- 3 cloves garlic
- 1 tbsp oil
- lime juice
- Salt to taste
- white pepper
- 1 bunch of chopped celery
- ¹/₂ cup white wine
- 1 tbsp pomegranade molasses

Season the fish with all ingredients above and chill for 1 hour. Dip the fish in flour and cook on a Teflon grill. Set aside.

Side dishes

- 2 red onions
- boiled baby beets

Slice onions and beets and cook in a Teflon pan with a drizzle of virgin olive oil, salt, pepper and onion.

Arrange the fish on a platter, with the side dishes around and a little bowl of Pitanga Cherry sauce.





Roast bass with almonds and Pitanga Cherry sauce Baby beets and baby sweet potatoes

- 4 fillets of sea bass
- lime to season
- extra virgin olive oil
- salt
- Fresh parsley and green onions
- 1 sprig of rosemary
- 1 tsp ground bay leaf
- 1 cup white wine
- 1 onion, finely chopped
- 3 cloves garlic, crushed
- 1 cup basic Pitanga Cherry sauce

Season the fish with all the spices and let it marinate overnight.

The next day, place the fish in a baking pan on a bed of 1 chopped onion and two chopped tomatoes. Pour the marinated sauce over and the basic Pitanga Cherry sauce on top. Cover with foil and bake for 30 minutes.

Serve in a bowl with any side dish. We suggest cooked baby beets with baby sweet potatoes lightly seasoned in garlic.





Bicolor bass with Pitanga Cherry sauce and hearts-of-palms

- 2 thick pieces of bass
- Lime
- salt
- ¹/₂ cup white wine
- 1 pinch of white pepper
- 3 cloves garlic, crushed
- juice of 1 lime
- 1 cup basic Pitanga Cherry sauce
- raw cabbage, thinly sliced
- roasted cashew nuts

Season the sea bass with lime, garlic, salt, pepper and wine. Refrigerate for 3 hours.

Palm sauce:

Place 4 cooked hearts of palm , 1 cup of cold milk, salt, 50g Parmesan cheese, 1 can of 250 g of milk cream. Blend well and set aside. In a pan, fry ½ onion with 1 tablespoon butter. Add the cream of palm and cook thoroughly.

Place the sea bass in a frying pan to brown both sides until it is cooked.

Arrange the bass on a platter, placing the heart of palm cream on one side and the Pitanga Cherry sauce on the other. Sprinkle the cabbage and roasted cashew-nuts.





Meatballs with Pitanga Cherry and jabuticaba sauce

Meat

- 300 g lean ground beef
- chopped parsley
- chopped green onions
- 1 tsp salt
- 1 tsp oregano
- 1 tsp Syrian pepper
- 1 tbsp flour

Put everything in a bowl and mix all ingredients well. Make small balls and fry in a pan with oil.

Sauce

- 1 cup basic Pitanga Cherry sauce
- 1 tbsp jabuticaba syrup
- 1 tbsp tamarind syrup
- fresh thyme
- chopped parsley

In a pot, combine the basic cherry sauce, the jabuticaba and the tamarind syrups. Add the parsley and thyme and cook thoroughly over low heat. Add the meatballs and simmer for 10 minutes.

Place on a platter and garnish with pine nuts and pistachio.





Roast tenderloin with beans and lentils in Pitanga Cherry sauce

- 300 g tenderloin
- 1/2 cup red wine
- 1 pinch of salt
- 1 pinch of oregano
- ¹/₂ tbsp Anatto coloring
- 1/2 tbsp sweet paprika
- 2 tbsp extra virgin olive oil
- 1 sprig of rosemary
- 1 onion, grated
- 3 cloves garlic, crushed

Season the meat with all ingredients and let marinate in the refrigerator overnight. The next day, put the juice marinade in a bowl. Add 2 teaspoons mustard and let it dissolve thoroughly. Dip the meat for 10 minutes.

In a Teflon pan brown the meat until it is thoroughly cooked on the outside.

Place the remaining marinade sauce in a pan, add 1 cup of basic Pitanga Cherry sauce and simmer for 10 minutes.

The beans and lentils can be canned, which have a very good texture. 1 can of beans and 1 can of lentils may be seasoned in a skillet with a little olive oil, 2 cloves garlic and $\frac{1}{2}$ a cube of vegetable broth.

Slice the tenderloin thickly and put it on a platter, placing the beans and lentils around. Then pour the Pitanga Cherry sauce on the meat and finish with a little parsley.





Roast maminha with olive and Pitanga Cherry and pomegranate sauce Provencal green beans and baked potato on the side

- 250 g maminha
- 2 onions, grated
- 4 cloves garlic, crushed
- 1 cup red wine
- 2 tbsp good quality olive oil
- salt
- Syrian pepper
- green onions
- thyme
- ¹/₂ tbsp Anatto coloring
- chopped olives
- 2 whole tomatoes, chopped
- 1 cup water

Season the maminha with all the ingredients and let marinate for 2 hours. Place it in a roasting pan and add a cup of Pitanga Cherry sauce. Place 2 slightly cooked potatoes (not quite cooked) cut into slices. Cover with foil and bake.

When it is roasted, cut the meat into slices and pour the sauce on top.

Suggested side dishes: besides potatoes, you can use green beans Provencal (garlic and oil) or even artichoke bottoms.







Pitanga Cherry syrup

- 500 g of Pitanga Cherry pulp
- 200 g sugar
- 1/2 tsp vanilla
- 1 cup of any liquor

Mix everything in a saucepan and bring to a boil over low heat until thickened.

Pitanga Cherry jam

The Pitanga Cherry jam is the first step in the production of several cherry candies. As the cherry pulp is low in proportion to the seed, it is difficult to separate it in the domestic kitchen. Even so, we suggest the jam is always homemade from the fresh or frozen fruit. The fact that the Pitanga Cherry is rich in pectin allows the production of jam.

- 1 kg of fruit fresh or frozen
- 250 g sugar

Put the fruit and sugar in a pot and bring to boil, stirring constantly. When boiling, lower heat and continue stirring until the seeds separate from the fruit and the syrup thickens. When it is at jam consistency, turn off the heat, pour the contents into a sieve and press to separate the husks and seeds from the jam. Store in an airtight container and keep in refrigerator.





Pitanga Cherry pie with pistachio candy

Dough

- 3 cups flour
- 2 tbsp butter
- 1 cup sugar
- 1 tbsp baking powder
- 1 dash of vanilla
- 1 egg yolk

Mix all ingredients in a bowl and add cold milk gradually until combined.

Filling

- 1 jar Pitanga Cherry jam
- 100g ground pistachio

In a tart pan with removable bottom, spread the dough with your hands over the entire surface including the edges. Spread the filling evenly and top with remaining dough strips. Brush with egg yolk and bake at 180 degrees.





Buffalo ricotta pie with pistachio, marmalade and Pitanga Cherry

Dough

- 300 g flour
- 1/2 tbsp baking powder
- 1 tsp vanilla
- lime zest
- 2 tbsp unsalted butter or margarine
- 1 and 1/2 cup sugar
- 1 egg yolk

Fiiling

- 1 pot of buffalo ricotta
- 1 egg yolk
- 150 g sugar
- 1/2 tbsp vanilla
- 100 g pistachio, crushed
- 150 g soft marmalade
- 100 g Pitanga Cherry jam

Spread the dough with your hands in a round pie pan with removable bottom. Leave part of the dough to make strips for the top.

Add the pistachios to the filling and put in the dough. Gently place the mixture of marmalade and cherry jam over the ricotta.

Cut the remaining dough into strips and make a grid over the filling. Brush with egg yolk and sprinkle with plenty crushed pistachio.

Bake thoroughly at 180 degrees.





Pitanga Cherry cake

- 300 ml Pitanga Cherry juice
- 1 cup cornstarch
- 2 cups flour
- 1 cup sugar
- 2 tbsp butter
- 1 tbsp of baking powder
- 1/2 tbsp vanilla
- 4 eggs

Whisk the egg yolks, butter, sugar and vanilla, and sift the flour and cornstarch together, add the cherry juice, the baking powder and finally the beaten egg whites. Place in greased cake pan and bake for 30-40 minutes.





Mascarpone foam with coconut and vanilla, Pitanga Cherry jam and marshmallow

- 300 g mascarpone
- 1/2 tbsp vanilla
- 1 ¹/₂ cup sugar
- 2 egg yolks
- 1 jar of cherry jam
- 1 grated coconut
- lime zest
- mint leaves

In a mixer, place the mascarpone, egg yolks, sugar and vanilla and beat until combined. Gradually add half the coconut. Set aside.

Make a firm marshmallow with the egg whites and set aside.

In a deep transparent platter place layers of mascarpone, cherry jam, and lastly the marshmallow interspersed with the remaining coconut. Sprinkle with lime zest and mint leaves. Serve chilled.





Marshmallow dessert with raspberries and Pitanga Cherry syrup

- 2 egg whites, room temperature
- 1 pinch baking powder
- 6 tbsp sugar
- 50 g raspberry
- 50 g cherry syrup

In a mixer, beat the egg whites and the baking powder until mixture is firm. Gradually add sugar and beat thoroughly until you have a thick and firm marshmallow.

Place in a glass bowl alternating with layers of raspberries and Pitanga Cherry syrup. Serve chilled.

Pitanga Cherry Jam

"The Pitanga Cherry is eaten raw, but also makes excellent jam".

Jacques Johan von Tschudi in "Viagem às Províncias do Rio de Janeiro e São Paulo" (Journey to the Provinces of Rio de Janeiro and São Paulo), 1857.

bitterness and a wild taste that sugar can not mitigate, unlike



