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Physical and Chemical Characteristics of Tropical and Non-Conventional Fruits

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1. Introduction

Fruit quality is one of the most important themes of fruit industry, especially when concerning juice and pulp ones, since they have a direct impact on the use of synthetic products such as acidifiers, colorants and sugars, for instance, i.e., fruits with adequate physical and chemical properties have the use of synthetic composts reduced on their processed products.

The physical and chemical parameters of fruits are important indicators of their maturation and internal and external quality, decisive factors for accomplishment of market demands, that have encouraged a lot of researches under different conditions overseas.

In this sense, this book chapter includes three themes related to fruit quality for industry: i) the importance of physical and chemical characteristics of cultivated tropical fruits; ii) the effects of management techniques on fruit quality; and iii) the physical and chemical characteristics of non-conventional fruits.

2. Importance of physical and chemical characteristics of cultivated tropical fruits

Quality is defined as the absence of defects or degree of excellence and it includes appearance, color, shape, injuries, flavor, taste, aroma, nutritional value and being safe for the consumer (Abbott, 1999). Due to a higher market exigency as for high quality products, the juice and pulp industries have been looking for fruits with better internal and external features, including fruit length and width; fruit weight; pulp, seed and peel percentages per fruit; number of seeds per fruit; seed size and peel diameter; soluble solids (ºBrix); titratable acidity (%); vitamin C content (mg/100g of fresh fruit); pulp pH and soluble solids/titratable acidity ratio.

The maintenance of fruit quality characteristics (internal and external features above cited) demands postharvest handlings, such as: preventing mechanical injury, water loss and disease development, limiting unwanted physiological changes and preventing chemical and microbial contamination (Cook, 1999). It is important to mention that farmers, packers, shippers, wholesalers, retailers and consumers frequently have different perspectives regarding to quality and often place different emphasis on the different components of quality. In addition to that, Paull & Duarte (2011) reported that fruit quality is related to some intrinsic characters (appearance, colour, acids, sugars, etc.) and since they change during handling research data can give us information on the waya product should be handled postharvest.

Inherently, the demand of fruit quality, physically and chemically talking, by industries, depends on fruit species and the product processed by each one of them.

Orange juice industry requires fruits for processing during all months of the year, what can be considered a great problem since the most cultivated orange cultivars in São Paulo State are, for instance, Hamlin, Natal, Pera and Valencia (Cavalcante et al., 2009a), whose production is concentrated in few months, fact that makes the commercial activity vulnerable to incidence of harmful diseases and concentrated juice price fluctuations. This way, lots of research work have been developed aiming the expansion of harvest time through new cultivars, with different fruit maturation curves as for the most recently cultivated ones, such as Cavalcante et al. (2006b), which has established a physical and chemical characterization of eighteen orange cultivar fruits and has also concluded that some of them presented potential for consumption as fresh fruit while others are much more appropriate for industry, indicating the importance of diversification.

Cavalcante et al. (2009a) evaluated, under São Paulo State (Brazil) conditions, fruit maturation of 18 sweet orange cultivars and have found that, according to Figure 1, four groups are formed considering its maturation: Orange cultivars João Nunes and Hamlin are the earliest ones, followed by Kawatta, Mayorca, Rubi and Westin; Pineapple and Tarocco A and Oliverlands, Cadenera and Homosassa, respectively; while Torregrosa, Jaffa, Biondo, Finike, Sanguinea, Moro and Early Oblong are the cultivars whose maturation is later than the other ones studied.

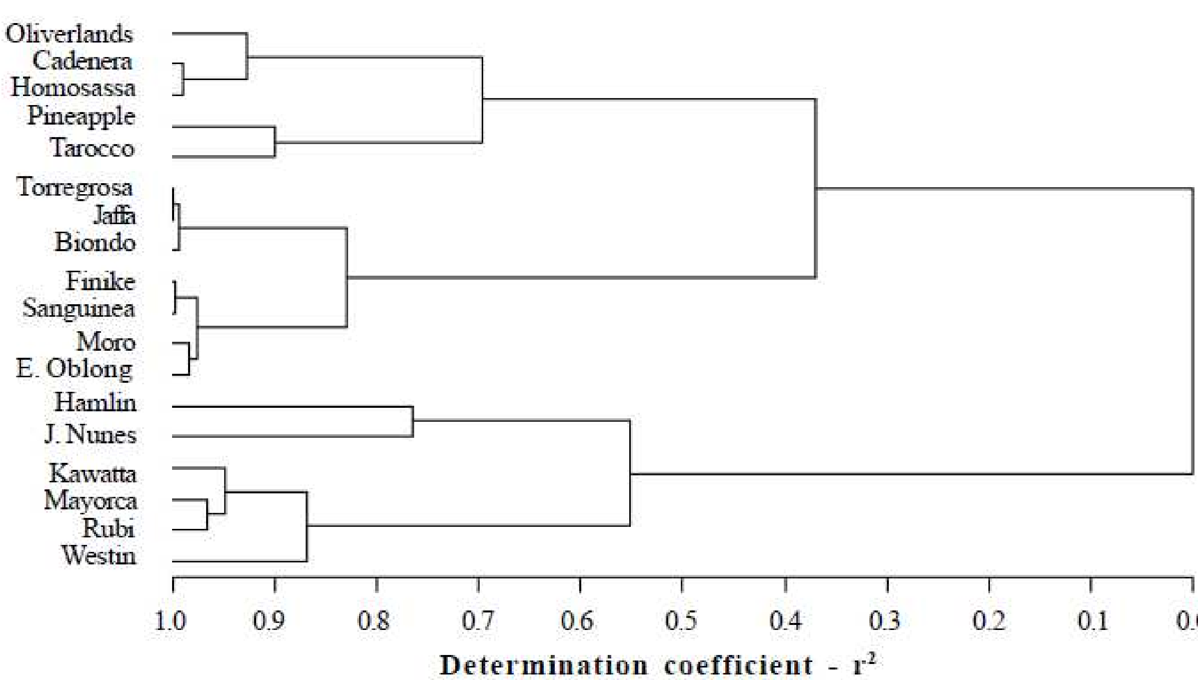

Fig. 1. Cluster diagram of sweet orange cultivars, obtained with SS/TA ratio, technological index and fruit mass. Cavalcante et al. (2009a)

Underutilized citric fruits also have been studied in Brazil aiming to provide, to orange industry, new options. One of these species is sour orange (*Citrius aurantium* L.; Figure 2), generally more consumed by people in Piaui State (Northeasthern Brazil) as for juice or fresh fruit than common orange (*Citrus sinensis* L.) cultivars. Silva Júnior et al. (2010) evaluated the physical and chemical properties of "laranja da terra" (in English, "native orange") fruits and concluded that its fruit presents good physico-chemical properties, with an average of 125.76 mg/100g of fresh fruit, indicating that it is a good natural source of vitamin-C; "laranja da terra" fruits present low titratable acidity and high soluble solids, so they have a great potential for consumption as fresh fruit. Further studies are necessary to determine the technological parameters for its consumption as fresh or processed fruit.

Fig. 2. Sour orange (*Citrus aurantium* L.) fruit.

It is important to detach that, orange fruit maturation considers, mainly, the concentration of soluble solids (ºBrix) and titratable acidity (%), while soluble solids: titratable acidity ratio (SS/TA ratio) of 12 (Di Giorgi, 1990), in a general way, is required for orange harvest aiming pasteurized juice industry and focusing the more profitable harvest time for farmers.

Another important fruit for industry is acerola (*Malpighia glabra*) also known as Barbados cherry. The importance of this species is directly related to the chemical and nutritional status of its fruits, especially vitamin C content, which has motivated the expansion of the cultivated area and has increased the demand for acerola in the world market. On the other hand, vitamin C content of acerola fruits depends on plant genetics since, according to Cavalcante et al. (2007a), high variability in fruit quality is observed in Brazilian acerola crops, especially those propagated by seeds. In this area, Cavalcante et al. (2007a) developed a research work with the objective of evaluating physical and chemical characteristics of fruits of sixteen acerola genotypes in Jaboticabal, São Paulo State, Brazil, and they have observed that eleven groups were formed, what indicates high variability among the acerola genotypes studied in relation to fruit quality parameters. This way, some genotypes presented potential for consumption as fresh fruit and others for industry. Figure 3 shows acerola fruits of genotype ACER-3, which presented almost 1.200 mg of vitamin C in 100g of fresh fruit, fruits with 6.9 ºBrix, 0.73% of titratable acidity, pulp percentage of 47% and fruit weight 6.82g.

Fig. 3. Acerola fruits of genotype ACER-3 from the Active Germplasm Bank of São Paulo State University, Brazil.

Among the other members of *Caricaceae* family, the cultivated papaya (*Carica papaya* L.) is the only one that belongs to *carica* genus. Papaya fruit is native of tropical America, where it is popular and grows for its small to large melon-like fruit.

In consonance with Paull & Duarte (2011), papaya fruit is a fleshy berry, from 50 g to well over 10 kg, and it superficially resembles a melon, being spherical, pyriform, oval or elongated in shape. Fruit shape is a sex-linked character and ranges from spherical to ovoid in female flowers to long, cylindrical or pyriform (pear-shaped) in hermaphrodite flowers. The skin of the fruit is thin and it is usually green when unripe, turning to yellow or orange when ripe, with flesh total soluble solids ranging from 5% to 19%.

In Brazil, the main papaya production country worldwide (Fao, 2011), papaya has been widely produced aiming its consumption as fresh (mainly) or processed fruit into various products, such as chunks and slices for tropical fruit salads, dehydrated slices, cocktails or processed into puree for juices and nectar base, usually frozen; and as canned nectar, mixed drinks and jams, because the puree of papaya fruit is the basis for the remanufacturing of many products. For papaya fruit evaluation, many studies have been conducted in order to understand the postharvest factors that influence papaya quality just as Bron & Jacomino (2006) and Mesquita et al. (2007), and others have been developed on the importance of an extra variable and on fruit firmness. Better firmness of papaya fruit delays membrane lipid catabolism thus extending storage life of fresh fruits, what could be improved by fruit treatments before its ripening, likeextra calcium supply, the same manner Mahmud et al. (2008) has studied and verified that the infiltration treatment at 2.5% demonstrated the best effect on maintaining fruit firmness. Additionally, the desired effect of calcium infiltration at 2.5% on maintaining fruit firmness may be due to the calcium binding to free carboxyl groups of polygalacturonate polymer, stabilizing and strengthening the cell walls, as explained by Conway & Sams (1983).

Another very appreciated tropical fruit specie in North Eastern of Brazil is yellow mombin (*Spondias mombin* L.), a native fruit with expressive potential for food industry in this region, concerning the sensorial quality of its fruit, being a species that should be used for more extensive commercial crops. During the last years, yellow mombin have been commercialized in higher amounts on different commercial sectors and Brazilian regions, mainly due to the possibility of fruit consumption as *in natura* or processed.

Cavalcante et al. (2009b) evaluated physical and chemical characteristics of yellow mombin fruits [fruit mass, width and length of fruits and seeds, percentages of pulp, skin and seed, water (%), soluble solids, industrial index and pulp pH] for consumption as fresh or processed fruit from natural plants native of North Eastern of Brazil. These authors revealed that yellow mombin fruit mass evaluated varies from 8.36 to 20.4 g; soluble solids and pH are in agreement to the standard market parameter (i.e. SS>9.0 ºBrix and pH>2.2) but pulp percentage of most evaluated counties was below food industry exigency, which standardized the minimum of 60% for pulp percentage. The industrial index for yellow mombin fruits reached 9.0%, pointing out that, for fruit industry, higher industrial indexes are required focusing a prominent possibility of higher soluble solids concentrations. This way, 9.0% is considered a satisfactory index for yellow mombin fruits.

Custard apple (*Annona squamosa* L.), also known as sweetsop (English); anon, riñón (Spanish); noina (Thai); nona seri kaya (Malay); custard apple (Indian); and pinha, ata or fruta-do-conde (Portuguese), is a fruit species native of tropical America, occurring spontaneously in Northeastern Brazil, where it is exploited mainly as subsistence without adequate management and without genetic material selection. Custard apple fruit has been usually consumed as dessert, i.e., several custards and fine desserts, which can include combinations with whipped cream and meringues. Adversely, the perishable nature of the fruit and often short supply limits availability to local markets or air shipment to more-distant markets. On the other way, lately, custard apple fruit has been studied for being included among tropical fruits widely used by industry due to its flavor and high concentrations of titratable acidity, which is particularly important for fruit processing, reducing the addiction of artificial acid components.

In a research work on custard apple fruits, Cavalcante et al. (2011b) evaluated yield, physical and chemical characteristics of the fruits of ten sugar apple genotypes in Bom Jesus, Piauí State, Brazil. The best results of the mentioned study have revealed that custard apple fruits presented a relation between longitudinal diameter and transversal diameter of 1.09, what classifies them as good quality fruits, according to the format variable, with an average fruit weight of 203.69 g, 11 seeds per fruit, soluble solids of 22.8ºBrix, titratable acidity of 0.16% and vitamin C of 138.55 mg/100g of fresh fruit; results that characterize custard apple fruits as a natural source of vitamin C.

Tropical fruits are usually sold fresh, and off-grade fruit is processed, exception done for coconut, which is grown mainly for the production of other products, such as copra, oil and coir with a small acreage, often of special varieties that are grown for fresh consumption of its water of albumen, fact that highlights that coconut fruit, among tropical fruits, is classified as a low water moisture loss rate. In Brazil, coconut has been grown preferentially for food industry purposes as for its water of albumen, although fresh water consumption is very appreciated by people.

3. The effects of management techniques on fruit quality

In general, the most important quality factors for tropical fruit growers, production managers, processors, and packers are fruit juice content, soluble solids and acid concentrations, soluble solids-acid ratio, fruit size, and color, showing that these characteristics may change regarding fruit species.

Fruit qualities, when consumed, are decided largely before harvest and depend on the variety grown, crop management (fertilization, irrigation, etc.), environment [climate (excessive rainfall causes major problems with flowering, pests, diseases and fruit quality) and soil] and other preharvest factors. Specifically, fruit quality, depends on several factors including cultivar, rootstock, climate, soil, pests, irrigation and nutrition, although standardized foliar levels have not been established for some tropical fruit species yet, such as yellow passion fruit, coconut and papaya.

In this sense, some of other research works have been developed aiming to measure the contribution of each factor on fruit quality for several tropical fruits and, additionally, trying to reduce the use of synthetics for the production of fruits with less inorganic products and they have also have as their objective the production of adequate amounts of high-quality food, protecting resources and being both environmentally safe and profitable.

Since excessive irrigation and fertilization reduce fruit quality, supplying sufficient nutrition and using sound irrigation scheduling techniques should be a high-priority management practice for every tropical fruit grower. Each fruit species requires a properly designed, operated, and maintained water management system and a balanced nutrition program formulated to provide specific needs for maintenance, expected yield and fruit quality. Such information depends on scientific studies to make fruit production reach high incomes and to manage adequately environmental factor.

Accordingly, irrigation contributes to the efficiency of nutrient programs because fruit trees with sufficient water and nutrients grow stronger, tolerate pests and stresses in a better way, yield more consistently, and produce good quality of fruit.

Adversely, deficient or excessive irrigation or fertilization may result in poor fruit quality, considering that the most important management practices that influence fruit quality are irrigation and an adequate nutrient management, mainly in relation to nitrogen, phosphorus, potassium, and magnesium. In addition to that, some micronutrients like boron and copper, in deficient plants, can also affect fruit quality, as long as when any nutrient is severely deficient, fruit yield and fruit quality will be negatively affected.

Among many economically important tropical fruits, in this book chapter, yellow passion fruit (*Passiflora edulis* f. flavicarpa Deg), coconut (*Cocos nucifera* L.) and papaya (*Carica papaya*) are going to be focused.

Yellow passion fruit is one of the most potentially fruitful plants for tropical regions, where climatic and soil conditions are favorable for its cultivation. Yellow passion fruits produced in Brazil present good flavor, high nutritional value, pharmacological applications and they are especially consumed as juice, although being also very appreciated as cold drinks, yogurt, sauce, gelatin desserts, candy, ice cream, sherbet, cake icing, cake filling, meringue or chiffon pie, cold fruit soup, or cocktails.

Fruit quality of yellow passion fruit has been widely studied since it is affected by several agronomic treats during crop growth, such as fertilizing, mulching, biofertilizing, irrigation water quality in relation to salinity and soil water losses.

In a study about potassium fertilizing of yellow passion fruit, Campos et al. (2007) registered weightier and sweeter fruits in plants submitted to larger amounts of potassium, agreeing with Marschner (2005), who informs us about potassium influence on increasing soluble solids of fruits.

The effect of mulching is also confirmed because it reduces soil water loses for atmosphere trough evaporation and, consequently, soil moisture becomes higher on root zone making it possible a better nutrient solubility and availability for plants. Campos et al. (2007) verified increase in fruit soluble solids (ºbrix) from plants grown with soil mulching, with a quantitative difference of 0.2 ºbrix; additionally, Freire et al. (2010) found that soil mulch promoted enhancement on fruit weight, fruit firmness, pulp percentage, pulp pH and ascorbic acid, important variables for fruit industry, specially for yellow passion fruit which is at most consumed in processed forms.

Another important theme on yellow passion fruit quality is the use of saline water for growth and production of this tropical fruit. In tropical regions, where water availability is restricted to low quality in relation to salt contents but climatic and soil conditions are adequate for yellow passion fruit growth, researchers have tried to find alternative managements to make its cultivation viable. North-Eastern Brazil is one of these regions, in which, nowadays, there is an important production of yellow passion fruit, in many cases, under irrigation with saline water.

Costa et al. (2001) characterized yellow passion fruit from plants irrigated with different saline levels and concluded that water salinity higher than 3.0 dS m^{-1} does not affect the external and internal quality of fruits. In the same study, it was reported that fruit quality related to pulp percentage, soluble solids, titratable acidity and vitamin C contents were similar to standardized values for plants irrigated with good quality water. These successful results were possible because, as forthis study, planting pits without coating (R0) and with side coatings (R1; R2; R3; R4; respectively one, two, three and four lateral sides) were used, so plating pits with coating, promoted a better water use and, consequently, better fruits. Accordingly, Cavalcante et al. (2005) found a positive correlation between pit coating and number of fruits and fruit weight, under irrigation with saline water, i.e., coated pits increased fruit production under irrigation with saline water with results compatible to fruit production by plants irrigated with good quality water. Cavalcante et al. (2003) associated soil mulch with saline water levels for yellow passion fruit production and identified that increasing salinity of irrigation water has no effect on fruit quality when soil mulch also was used, it was also noticed that soluble solids (ºbrix), titratable acidity and pulp pH produced under irrigation with saline water and soil mulching are compatible to low demanding markets.

Yellow passion fruit is also positively affected by organic fertilizers, such as biofertilizers, which are obtained by anaerobic fermentation and could be simple [water + fresh bovine manure] at a ratio of [1:1] (in volume) or enriched [water + fresh bovine manure + a protein mix + nutrient sources], as can be seen in figure 4, adapted from Cavalcante et al. (2011c).

During the last years, biofertilizers have emerged as an important component of the integrated nutrient supply system and they have been tested on yellow passion fruit production and nutrition through environmentally better nutrient supplies. It is possible to find in the scientific literature some research work that has studied biofertilizers effects on fruit quality of yellow passion fruit, including the ones under irrigation with saline water. According to Cavalcante et al. (2011a), fruit quality and nutritional status of yellow passion fruit are affected by biofertilizer doses applied; fruit length, width, pulp percentage, skin diameter, mass, soluble solids and titratable acidity were improved with biofertilizer application, independently of type; simple biofertilizer promotes optimum supplies of potassium, calcium and sulphur, while enriched one promotes optimum supplies of nitrogen, phosphorus, potassium and calcium; and bovine biofertilizer is an important key to the production of yellow passion fruit with less use of chemical fertilizers, maintaining fruit quality.

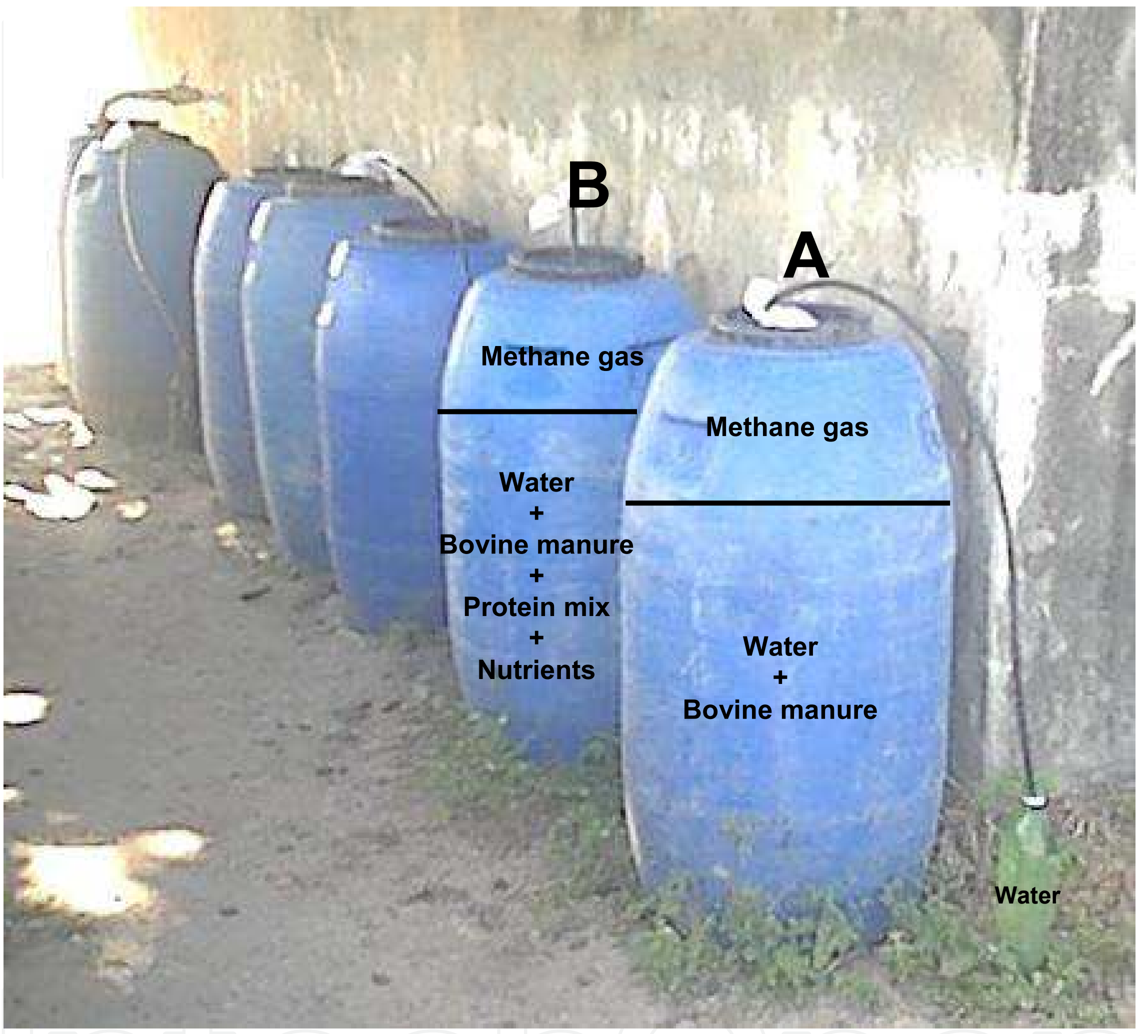

Fig. 4. Preparation system of both biofertilizers (simple - A; enriched - B) by anaerobic fermentation.

Cavalcante et al. (2007b) reported that enriched biofertilizer inhibited the mean weight of fruits and yield of yellow passion fruit in relation to simple biofertilizer, and fruits produced under simple fertilizer use were compatible to the average standardized fruit weight of 200g quoted by Meletti et al. (2002). Despite, different results can be found: Rodrigues et al. (2008), adversely, concluded that yellow passion plants submitted to enriched biofertilizer produced adequate titratable acidity (citric acid) and low pulp percentage and vitamin C content, including that soluble solids (ºbrix) ranged from 12.9 to 13.9ºbrix, thus above the limit of 11ºbrix required by the industry (Anonymous, 1999).
Simple biofertilizer promoted enhancement on titratable acidity of yellow passion fruits (Dias et al., 2011), what is pretty much important for juice industry, since it reduces the addition of artificial acid components. Furthermore, all the yellow passion fruit plants

biofertilized in the work cited above presented the minimum titratable acidity required by juice industry, which is 2.5% (Anonymous, 1999). Dias et al. (2011) also concluded that higher biofertilizing frequency stimulates pulp percentage, titratable acidity, vitamin C contents and juice electrical conductivity. Enriched biofertilizer affected yellow passion fruit mass, promoting production of fruits with average mass compatible to the fresh fruit market (Rodrigues et al., 2009).

Coconut is another tropical fruit which is influenced by management techniques. According to Ferreira Neto et al. (2007), the mean weight of fruit is not influenced by the application of N and K through fertigation, but increasing N has decreased water volume and °Brix and increased pH, while increasing K dose has decreased salinity and increased ºbrix of coconut water. On another paper, Silva et al. (2006) verified that coconut water volume is affected by nitrogen and potassium, since the maximum coconut water volume observed (417.75 mL) was found when 818 g of nitrogen plant^{-1}year^{-1} and 1487 g of potassium plant^{-1}year^{-1} were tested. Nitrogen and potassium levels also demonstrated a linear effect on the soluble solids content of coconut water, on which nitrogen had a negative and potassium a positive effect. A negative linear effect was observed between nitrogen concentration and electrical conductivity of coconut water, while it was observed that potassium levels showed a quadratic effect on this same parameter. Coconut water quality is directly and mainly affected by coconut plant genotype, maturation, plant nutrition, irrigation and climatic conditions, thus it is important monitoring all fruit growth and maturation circle to obtain fruits with high amounts of water, what is very important for coconut water industry.

As for papaya fruit processing it is necessary good quality fruits, produced under low costs, as suggested by Mesquita et al. (2007), who have evaluated the fruit quality and yield of papaya fertilized with bovine biofertilizers. The results of their study, except for fruit firmness, registered positive effects of the biofertilizers on 'Baixinho de Santa Amália' papaya cultivar in relation to yield, physical and chemical fruit quality.

4. Physical and chemical characteristics of non-conventional fruits

The higher and increasing demand, during the last decades, for exotic fruits has offered greater variety in the production market, the same way expanded marketing opportunities have been of fruit producers' interest, especially in Brazil where climatic and soil conditions are favorable for the production of non-conventional fruits. Equally, scientific information that characterizes these species in relation to quality and maturation of fruits is important to the development of this industry. In this sense, the determination of physical and chemical fruit characteristics constitutes an important reference for studies about the maturation and quality of fruits, with the ultimate aim of determining consumer acceptance requirements.

Additionally, nowadays, fruit consumers are becoming increasingly aware of health and nutritional aspects of their food, demonstrating a tendency of avoiding synthetic products, such as additives, in their food, since they are obtaining therapeutic effects and nutrition from natural resources. This way, non-conventional fruits could satisfy these demands because they are also produced, in most cases, without agronomic techniques, as mentioned chemical fertilizing and pesticides, especially in Brazil where the Agriculture Ministry regulates the pesticides, dividing them into two groups: the ones which have been scientifically tested and proved their efficiency and, the ones which have not been through this process concerning non-conventional fruits. On the other hand, many of these fruits are highly perishable and difficult to store in their fresh form, some of them are not acceptable

as fresh fruits due to its high acidity and/or a strong astringent taste, although most of non-conventional fruit have unlimited potential in the world trade in their processed form.
Reliable information about physical and chemical characteristics of non-conventional fruits is poorly found in scientific literature, including books and manuscripts around the world. Among the non-conventional fruits dovyalis (*Dovyalis* sp.), yellow mangosteen (*Garcinia* sp.) and mamey (*Pouteria sapota*) have particular importance and will also be focused in this chapter.
Dovyalis belongs to the Flacourtiaceae family native to India or Sri Lanka (Ferrão, 1999), which have fleshy, yellow, spherical in form, succulent and extremely acidic fruits (Figure 5). Cavalcante & Martins (2005) established the physical and chemical characterizations of dovyalis hybrid fruits (*Dovyalis abyssinica* and *D. hebecarpa*) and observed that dovyalis fruits have good physical qualities for the fresh market and juice industry averaging 75% pulp; soluble solids (SS) results ranged between 14.9 and 14.0%; titratable acidity (TA) was considered high, i.e., from 2.9 to 3.6 mg/100 g of fresh fruit. Consorting to these results, the SS/TA rate ranged between 4.1 and 5.4, numbers that are considered low, since the higher this ratio, the better fruit quality for fresh fruit consumption is. On the contrary, the 120.3 mg/100 g of fresh fruit content demonstrates that dovyalis fruit is a good natural source of vitamin C. However, further studies are needed to determine technological parameters for consumption as fresh or processed fruit.

Fig. 5. Dovyalis fruits from the Active Germplasm Bank of São Paulo State University, Brazil.

Another non-conventional and potential fruit is yellow mangosteen (*Garcinia xanthochymus* Hook), which is also known as false mangosteen and belongs to Clusiaceae family, which also includes 35 genus and more than 800 species (see Figure 6). According to Cavalcante et al. (2006a), yellow mangosteen fruits present 76.03-95.04g, 5.09-5.50cm in length, 5.54-5.72cm in width, 1.45-1.95 seeds/fruit, 71.13-76.61% of pulp percentage, 10.8-12.6ºBrix of soluble solids, 3.85-4.42% of titratable acidity and vitamin C content varying from 31.21 to 46.82 mg/100 of fresh pulp. These results indicate that yellow mangosteen fruit has a good pulp percentage, what is important for fruit industry; this is a very acid fruit with a TA average 3.51% and a good natural source of vitamin C, although this last variable is lower than that registered as for dovyalis fruits.

Fig. 6. Yellow mangosteen fruit from the Active Germplasm Bank of São Paulo State University, Brazil.

Mamey (*Pouteria sapota*) is native to Mexico and Central America and, after its introduction to Florida (USA), it has become much more known and sought especially by Latin Americans. Mamey is also known as mammee, mammee apple, St. Domingo apricot and South American apricot (English); mamey de Santo Domingo, mamey amarillo, mamey de Cartagena, mata serrano, zapote mamey, or zapote de Santo Domingo (Spanish); abricote, abrico do Pará or abrico selvagem (Portuguese); and abricot d' Amerique, abricot des Antilles, abricot pays, abricot de Saint-Dominque or abricotier sauvage (French).

Fruits of fresh mamey are consumed in fruit salads or served with cream and sugar or wine; they are also minimally processed and sliced to be used in pies or tarts, and may be seasoned with cinnamon or ginger. The mamey is widely turned into preserves such as spiced marmalade and pastes (resembling guava paste) and used as filler for products made of other fruits. Slightly under-ripe fruits, rich in pectin, are turned into jelly. Wine is made from the fruit and fermented "toddy" from the sap of the tree in Brazil.

Instead of the large options of mamey fruit consumption, it is still poorly studied in relation to fruit quality. This way, Nascimento et al. (2008) found large ranges of fruit quality parameters of mamey fruits in Brazil, i.e., average values ranged from 11.9-17.31cm in fruit length, 5.77-9.50cm in fruit width, 317.71-765.82g in fruit mass, 57.57-82.49% in pulp percentage, 20.60-26.40ºBrix of soluble solids, 0.51-0.07% of titratable acidity, 47.89-387.49 in SS/AT ratio and 12.29-36.98 mg/100 of fresh pulp, indicating that mamey fruit presents high pulp percentage, low titratable acidity and high soluble solids, demonstrating to be a good flavor fruit, but not a vitamin C source. In Figure 7 it is possible to identify mamey fruits.

Fig. 7. Yellow mangosteen fruit from the Active Germplasm Bank of São Paulo State University, Brazil.

In fact, there are many unconventional fruits also underutilized around the world, a lot to study, especially those which present potential for consumption as fresh or processed fruit, and much more have to be done and published to make good flavored but unconventional fruits, also traditional ones as for the main world fruit market.

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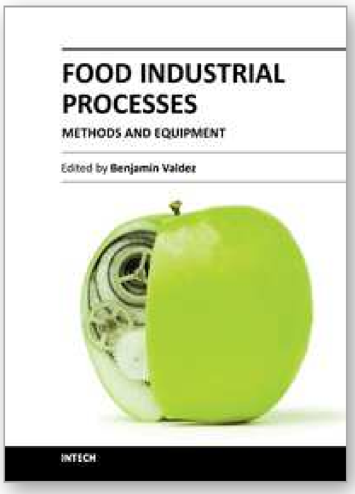

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The global food industry has the largest number of demanding and knowledgeable consumers: the world population of seven billion inhabitants, since every person eats! This population requires food products that fulfill the high quality standards established by the food industry organizations. Food shortages threaten human health and are aggravated by the disastrous, extreme climatic events such as floods, droughts, fires, storms connected to climate change, global warming and greenhouse gas emissions that modify the environment and, consequently, the production of foods in the agriculture and husbandry sectors. This collection of articles is a timely contribution to issues relating to the food industry. They were selected for use as a primer, an investigation guide and documentation based on modern, scientific and technical references. This volume is therefore appropriate for use by university researchers and practicing food developers and producers. The control of food processing and production is not only discussed in scientific terms; engineering, economic and financial aspects are also considered for the advantage of food industry managers.