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Physico-chemical Quality Parameters of Mango (*Mangifera indica* L.) Fruits Grown in a Mediterranean Subtropical Climate (SE Spain)

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ABSTRACT

Mango (*Mangifera indica* L.) production is on the rise in various subtropical zones throughout the world. The cultivation of this fruit tree is feasible along the coast of Granada, where some 1,500 ha are presently grown. In 2006, the EU exported 118 thousand tonnes of mangoes at a value of 131 million euros. This study was conducted to assess the physico-chemical quality characteristics of some mango fruit cultivars growing under a Mediterranean subtropical climate in Spain. A number of twenty-five fruits from eight Florida and one Australian cultivars were collected from different trees at the preclimacteric hard-green stage, and weighed. Osteen fruits bore the greatest weight (697±95 g) with their pulp:seed ratio ratios (20:2) significantly higher than those in the other cultivars tested. The lowest pulp:seed ratios were recorded for the cultivars Kensington (6.3) and Sensation (7.6). The fruits with the highest percentages of flesh belonged to *cvs.* Gleen, Palmer, and Osteen, each averaging 85%. The seed-weight of the fruits of *cv.* Osteen proved the lowest (4.2%) among all the cultivars, confirming the most desirable relationship with the pulp. The highest acidity (0.22%) went to Valencia Pride while Lippens contained the highest Total Soluble Solids (TSS). The TSS:TA ratios proved the highest for *cvs.* Kent (382) and Lippens (333), which might be indicative of the effect on their flavour. All the mango cultivars tested in this subtropical marginal area, especially *cvs.* Osteen and Tommy Atkins, met the standard parameters for high-quality fruits, and can be recommended for their performance and sustainable yield in such type of environments.

Keywords: Florida cultivars, Mango, Marginal area, Titratable acidity, Total soluble solids.

INTRODUCTION

Mango (*Mangifera indica* L. Family *Anacardiaceae*), is one of the most profitable crops in tropical and subtropical regions in the world. Originating in the Himalayan foothills of the Indian-Myanmar region, it has been cultivated for more than 4,000 years and is renowned for its excellent flavour, attractive fragrance, and high nutritional value. Mango can play an important role in balancing human diet by providing about 64-86 calories of energy per 100 g (Rathore *et al*., 2007) and, when consumed regularly, can be a valuable dietary source of many phytochemical compounds (Haard and Chism, 1996). In

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addition, among many other components, the ascorbic acid content makes the fruit an excellent source of vitamin C, its content varying from 32 to 200 mg per 100 g of edible pulp (Akinyele and Keshinro, 1980).

Over the last decade (1991-2001), mango growing area has increased by 42.5% (Malik and Singh, 2006), due to the interest increasing in the fruit's fresh as well as processed consumption (Materano *et al.,* 2004). The world production of the fruit is estimated to be over 23.4×10^6 tonnes per year and is expected to increase (Materano *et al.,* 2004). Spain is the main European producer of subtropical fruits, with approximately 1,400 ha dedicated to mango (Galán and Farre, 2005). In particular, the coast of Granada (SE, Spain) has a large potential for the cultivation of tropical and subtropical fruit trees, with a favourable year-round climate and infrequent frosts. In this region, hillsides have traditionally been terraced and today intensive irrigated agriculture has been established along with diverse tropical and subtropical crops, including avocado (*Persea americana* Mill.), mango (*Mangifera indica* L.), loquat (*Eriobotrya japonica* L.), custard apple (*Annona cherimola* Mill.), and litchi (*Litchi chinensis* Sonn.) among others (Durán *et al.*, 2003; 2006a). Mango orchards are established on the hillside terraces 2-3 m wide with single rows of mango trees spaced 3-4 m apart. A large number of Florida mango cultivars are grown in the study zone but the physico-chemical characteristics of most of them have not yet been studied for this crop and in this type of marginal area. Each mango cultivar is distinct from others in colour and flavour, and therefore varies in its suitability for certain uses. Mango was introduced to Florida in the 19th century, from the West Indies and from India. In the 20th century, there were further introductions from southern Asia (primarily from India and as well from other countries). As a result, a grade of mangoes called "Florida" was developed (Knight and Schnell, 1994; Olano *et al*., 2005), being hybrids between Indian (monoembryonic) and South-east Asian types (polyembryonic). As it is widely consumed but delicate fruit, care needs to be taken to conserve its quality from harvesting until consumption.

The aim of the present study is to assess the physico-chemical characteristics of mango fruits especially those of Florida cultivars growing in a marginal area under a Mediterranean subtropical climate in the coast of south-eastern Spain. This could be very important as regards consumers, marking new expectations of emerging markets.

MATERIALS AND METHODS

The study was carried out for two growing seasons at the experimental station "El Zahorí" (Almuñécar, SE Spain; 36º 48´00´´N, 3º 38´0´´W) (Figure 1). The local

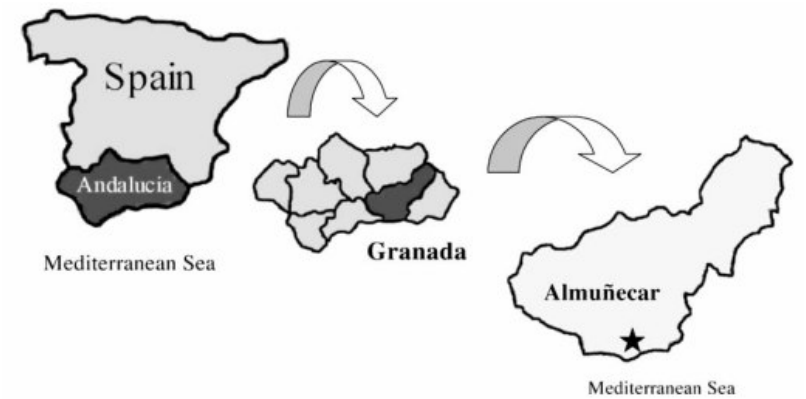

Figure 1. Location of the experimental site of Almuñecar, Granada (SE Spain).

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temperatures vary from subtropical to semi-hot within the Mediterranean subtropical climatic category (Elias and Ruiz, 1977). The average annual rainfall in the study zone is 449.0 mm; however, the Mediterranean climate shows a complex pattern of spatial and seasonal variability, which is exacerbated by the unpredictability of rainfall from year to year, within the year, and spatially during a single rainfall event (Ramos and Martínez, 2006). The soils, formed from weathered slates, vary in depth, and some being rocky, providing in general very good drainage. They are classified as Typical Xerorthent (Soil Survey Staff, 1999), with 684 g kg^{-1} of sand, 235 g kg^{-1} of silt and 81 g kg^{-1} of clay, containing 9.4 g kg^{-1} of organic matter, and 0.7 g kg^{-1} of N, with 14.6 mg kg^{-1} P and 178.7 mg kg^{-1} of assimilable K (MAPA, 1986). The experimental mango orchards were drip irrigated and managed according to conventional practices in the area, using the same fertilization (240 g N, 71 g P_2O_5, and 212 g K_2O) practices and routine cultivation techniques for diseases and insect control. Eight Florida mango cultivars were considered [Osteen (OS), Tommy Atkins (TA), Sensation (SE), Glenn (GL), Palmer (PA), Lippens (LI), Irwin (IR) and Valencia Pride (VP)] together with one Australian cultivar namely: Kensington (KE). The fruits were harvested during two seasons (2006-2007) from August to October at the appropriate harvest time of each cultivar.

At the preclimacteric hard-green stage, 25 fruits per cultivar were collected from different trees by a trained person. Within 24 h of being harvested, the fruits were taken to the laboratory where undamaged fruits were stored at 12ºC and 85-90% of relative humidity, conditions recommended by Salunkhe (1984), until they reached the proper maturity level for processing (about 7-10 days). Also, the daily weight loss of fruits until maturity was recorded. The fruits were peeled with the pulp, seed, and peel separated. Each fraction was weighed. The total soluble solids (TSS) was determined by use of refractometer (Eclipse, Bellinghan and Stanley, Ltd.) (AOAC, 1999); pulp samples were homogenized in a blender. From a few drops of thoroughly mixed sample, a direct refractometer reading was taken as described by AOAC (1984), the results being reported as Brix degrees at 20ºC. Titratable acidity was measured in the pulp through titration against NaOH, using phenolphthalein as an indicator. The data were expressed in % citric acid according to standard methods (AOAC, 1984):

% citric acid = V x N x Wmeq x 100 / Y,

Where: V = ml of NaOH solution used for titration, N = Normality of NAOH solution, W = Milliequivalent of citric acid of 0.064, and Y = sample weight (g)

Fruit samples (15 g) from each cultivar were homogenized for pH measurements through a digital pH meter (CRISON micropH2002). For texture measurements (kg m^{-2}), the fruits were peeled at two points in the equatorial area and the texture measured through a fruit penetrometer (fruit firmness tester) (PCE-PTR 200) with crossheads of 8 mm. Also shape, skin colour, pulp colour, skin-pulp adherence, and presence of fiber were recorded. At the ripe stage, an analysis for some fruit organoleptic characteristics was made (De Laroussilhe, 1980; IBPRG, 1989). Analysis of variance (ANOVA) using statistical analysis package (Statgraphics v. 5.1.) was performed to ascertain the differences in fruit parameters among the different mango cultivars. Differences among individual means were tested using the Least Significant Difference test (LSD) at $P< 0.05$ level.

RESULTS AND DISCUSSION

Figure 2 shows the average fresh fruit weight for each of the cultivars studied. The fruits from cv. Osteen (OS) carried the highest average weight (697±95 g), the difference with respect to the other cultivars being statistically significant ($P< 0.05$). By contrast, the Australian *cv.* Kensington (KE) had the lowest significant average weight

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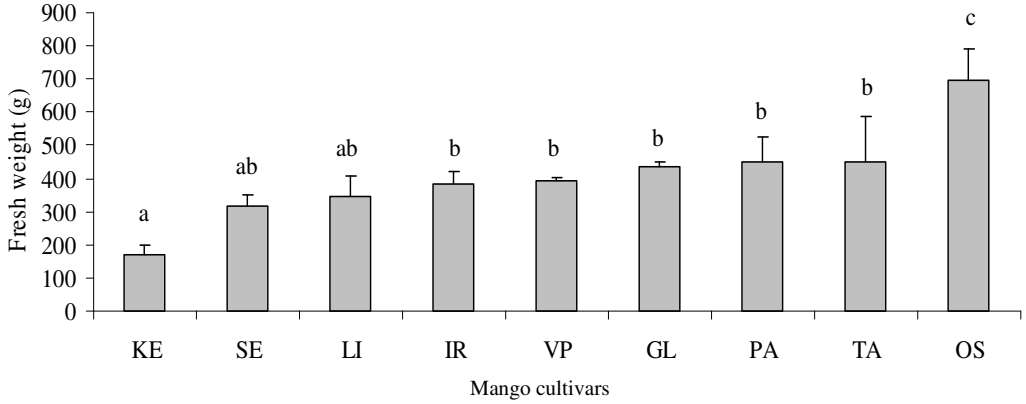

Figure 2. Average fresh weight for the cultivars studied at the maturity stage. TA: Tommy Atkins; LI: Lippens; SE: Sensation; OS: Osteen; IR: Irwin; GL: Gleen; KE: Kensington; VP: Valencia Pride, PA: Palmer. Vertical bars represent standard deviation. Different letters on columns are indicative of statistical difference (LSD, $P< 0.05$).

(171±28 g) while the rest of the cultivars did not statistically differ from each other. Thus, a medium-sized weight group was established for *cvs.* TA, PA, GL, VP, and IR, averaging 422 g, while a third group was comprised of *cvs.* SE and LI, averaging 332 g; and a fourth one constituted of *cv.* KE, weighing 171 g (Figure 2).

Similar weights for *cv.* Osteen fruits were found in the control treatment in the study area with a salinity experiment through Durán *et al*. (2004) (691 and 580 g for *cv.* Osteen fruits grafted on rootstocks Gomera-1 and Gomera-3, respectively) in south-eastern Spain. Regarding the remaining cultivars, comparable results were reported by Fernández *et al*. (2001) in Argentina for *cv.* Tommy Atkins (420.8 g), and by Soto *et al*. (2004) in Venezuela for *cv.* Irwin (345.8 g). By contrast, the average weight of *cv.* Valencia Pride found by the same author (562.3 g) was lower than that found in the present study. The *cv.* Kensington Pride (or Bowen) is the predominant variety in the Australian production (more than 95%) (Jacobi *et al*., 1998), but it is not widely marketed to Europe. In relation to *cv.* Sensation, findings similar to those in the present experiment have been reported by Yeshitela *et al*. (2004), in South Africa with an average fruit weight of 321 g.

The fruit is sold in the European market in quality classes based primarily on fruit size and (in some cultivars) colour, both traits being the main commercial characteristics of mango fruit of Florida cultivars that make them the most marketable fruits worldwide. Since weight is not a determining factor for quality in commercial terms the medium-sized fruits are more frequently appreciated by consumers. Internal quality components are not considered despite that a large or small fruit size can also be promoted in ways which do not necessarily guarantee high flesh quality. Pre-harvest growing conditions (*i.e.,* cultivation practices, plant material, and climate) exert a major impact on fruit development and quality. The effects of different growing conditions on fruit size and yield for two Florida cultivars (*cvs.* Osteen and Keitt) in the study area have been discussed by Durán *et al*. (2006b), showing the potential environmental conditions for theirs cultivation.

Figure 3 shows the pulp:seed ratio for all the cultivars, showing a similar trend found for weight. The highest pulp:seed ratio was found for *cv.* Osteen (20.2), while the lowest ratios for *cvs.* Kensington (6.3) and Sensation (7.6). In addition, the *cvs.* Tommy Atkins and Irwin recorded acceptable ratios of 13.1 and 15.9, respectively. According to Avilan *et al*. (1998), the ideal mango fruit

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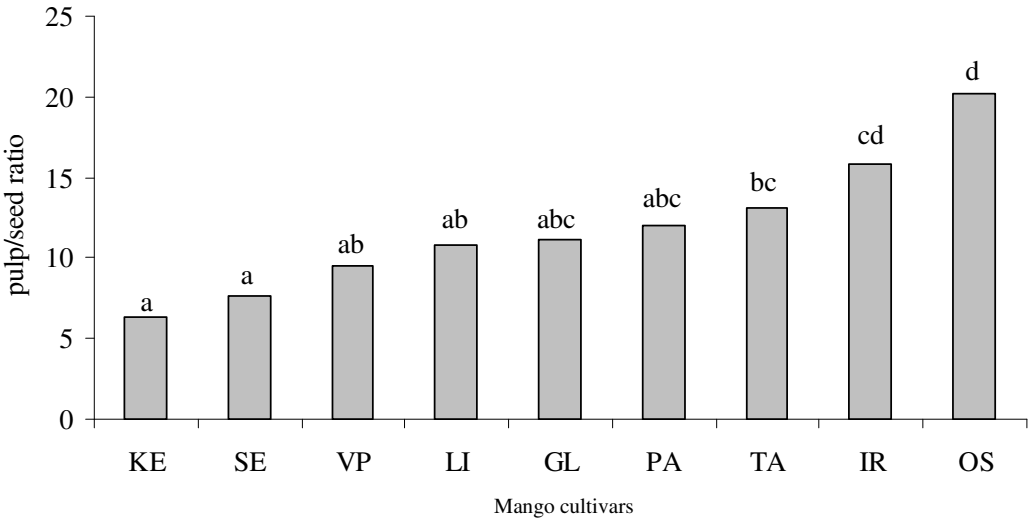

Figure 3. Pulp:seed ratios for the cultivars studied at their maturity stages. TA: Tommy Atkins; LI: Lippens; SE: Sensation; OS: Osteen; IR: Irwin; GL: Gleen; KE: Kensington; VP: Valencia Pride, PA: Palmer. Different letters among columns represent the statistical difference (LSD, P< 0.05).

benefits from a high pulp:seed ratio, good firmness, appropriate consistency, fibre absence, and an adequate sugar:acidity ratio. In this sense, the highest pulp:seed ratio was found for *cv.* Osteen, making it one of the most valuable commercial cultivars on the Granada coast, as pointed out by other authors (Calatrava *et al.*, 1993; Durán *et al.*, 2003).

Table 1 presents the fruit yield, fruit characteristics, and the percentage weight of fruit peel, seed, and flesh of cultivars studied. Fruit yield was highly variable among the cultivars studied, the highest being recorded for *cvs.* Tommy Atkins, Osteen, and Valencia Pride. The fruits with the highest percentage of flesh were *cvs.* Gleen, Palmer, and Osteen, with an average of 85%, whilst the lowest values were recorded for *cvs.* Kensington and Sensation, with 74 and 77%, respectively. For fruit skin, the lowest and highest values were

Table 1. Percentage weight of skin, seed and flesh for the mango cultivars studied.

Mango cultivar	Fruit yield (kg tree^{-1})	Skin weight (%)	Seed weight (%)	Flesh weight (%)	Fruit length (mm)	Equatorial diameter (mm)	Weight loss* (g day^{-1})
TA[a]	20.7 ± 8.1	11.2 ± 3.4	6.9 ± 2.2	81.9 ± 5.4	114.1 ± 8.6	92.4 ± 6.5	2.5 ± 0.4
LI[b]	13.5 ± 6.8	9.70 ± 1.1	7.7 ± 0.8	82.6 ± 1.5	91.4 ± 6.1	81.4 ± 5.3	2.1 ± 0.5
SE[c]	17.8 ± 9.7	12.0 ± 0.6	10.4 ± 1.5	77.6 ± 1.9	87.4 ± 5.2	72.5 ± 4.6	0.9 ± 0.4
OS[d]	19.0 ± 5.7	10.3 ± 0.8	4.2 ± 0.2	85.5 ± 0.6	126.8 ± 7.0	90.7 ± 5.4	2.7 ± 0.5
IR[e]	14.5 ± 7.5	10.8 ± 3.2	5.7 ± 1.9	83.5 ± 1.5	106.3 ± 5.7	78.4 ± 6.8	2.2 ± 0.3
GL[f]	11.2 ± 8.3	6.30 ± 0.9	7.8 ± 0.6	85.9 ± 1.5	104.1 ± 9.1	75.4 ± 6.5	1.9 ± 0.5
KE[g]	12.4 ± 8.7	13.4 ± 1.6	11.8 ± 0.6	74.6 ± 1.3	80.4 ± 8.3	75.1 ± 3.2	0.8 ± 0.4
VP[h]	19.4 ± 7.4	6.90 ± 1.3	8.8 ± 0.3	84.1 ± 1.0	105.4 ± 4.6	80.2 ± 4.8	1.7 ± 0.5
PA[i]	10.5 ± 6.8	7.30 ± 0.5	7.3 ± 1.7	85.4 ± 1.1	110.4 ± 7.8	91.8 ± 5.6	2.0 ± 0.4

* Fruit weight loss up to the maturity stage.
[a] Tommy Atkins; [b] Lippens; [c] Sensation; [d] Osteen; [e] Irwin; [f] Gleen; [g] Kensington; [h] Valencia Pride, [i] Palmer.
Average ± Standard deviation.

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found for *cvs.* Gleen and Kensington, with 6.3 and 13.4%, respectively. The seed weight for fruits in *cv.* Osteen was the lowest (4.2%) in comparison with the other cultivars, confirming a better relationship with the pulp. On the other hand, the percentages of seed contribution to the total fruit weight for *cv.* Tommy Atkins and Irwin were acceptable (6.9 and 5.7%, respectively). Cultivars Kensington and Sensation showed the highest percentages of seed to total fruit weight (11.8 and 10.4%, respectively). The thinnest peel (6.3%) was found for *cv.* Gleen, this value being in contrast with that of Soto (2004), who reported it as 21%.

Table 2 shows the pH, textural firmness, Total Soluble Solids (TSS) and Titratable Acidity (TA) for the cultivars studied, as well as their ratios. The cultivars studied differed significantly in acidity, the highest being reported for *cv.* Valencia Pride, with an average acidity of 0.22%. The lowest acidities were found for *cvs.* Kent and Lippens, with 0.04 and 0.06%, respectively. In relation to the Total Soluble Solids (TSS), the *cv.* Lippens showed the highest value among all the cultivars, values ranging from 19.5% for *cv.* Osteen to 15.7% for *cv.* Gleen.

The results of the present study for TSS are in general higher than those reported by Fernández *et al*. (2001) in Argentina for *cvs.* Tommy Atkins, Osteen, Sensation, and Valencia Pride of 14, 14, 16, and 19%, respectively. This may be due to the longer period of sunlight exposure, since in the present study the trees were cultivated in south-facing orchard terraces under European Mediterranean conditions. In this context, a positive relationship between light-exposure time and TSS content has been pointed out in other crops by different authors (Owusu *et al*., 1978; Tombesi *et al*., 1993). As TSS and the TSS:TA ratio is considered a measure of fruit quality, it is generally recognized that quality fruits benefit from a higher sugar:acid ratio whereas fruits of lower quality suffer from a lower sugar:acid ratio. In this context, Palaniswamy *et al*. (1975), from India reported a TSS:TA ratio for high-quality mangos for *cvs.* Khirsapat, Gopalbhog and Langra of 162.5, 150.0, and 131.3, respectively. According to the present findings the highest TSS:TA ratios were recorded for *cvs.* Kent (382) and Lippens (333). However, the cultivars which had an acceptable equilibrium between TSS and TA were *cvs.* Osteen, Tommy Atkins, Palmer, and Gleen with 144, 148, 142, and 121.3, respectively. Moreover, the TSS:TA ratios in these cultivars are similar to those reported by Palaniswamy *et al*. (1975).

The textural firmness is associated with the stage of maturity. Usually in the initial stages of fruit development, firmness remains almost constant whereas after firmness decreases as the fruit ripens,

Table 2. Texture, pH, Total Soluble Solids (TSS) and Titratable Acidity (TA) at maturity stage for the mango cultivars studied.

Mango cultivar	pH	Texture (kg m^{-2})	TSS(ºBrix)	TA(%)	TSS:TA ratio
LI[a]	5.7 ± 0.2 b	2.7 ± 0.6 b	20.0 ± 1.9 b	0.06 ± 0.02 ab	333.3
SE[b]	5.1 ± 0.3 ab	2.1 ± 0.2 ab	19.2 ± 0.8 ab	0.08 ± 0.01 ab	256.0
OS[c]	5.4 ± 0.1 ab	1.7 ± 0.5 a	19.5 ± 0.6 ab	0.14 ± 0.03 c	144.4
TA[d]	4.9 ± 0.5 ab	1.7 ± 0.3 a	18.4 ± 0.8 ab	0.12 ± 0.01 c	148.4
KE[e]	4.3 ± 0.4 a	2.0 ± 0.1 ab	17.2 ± 6.7 ab	0.05 ± 0.03 a	382.2
PA[f]	4.2 ± 0.2 a	1.7 ± 0.6 a	16.5 ± 0.7 ab	0.12 ± 0.01 bc	142.2
VP[g]	4.8 ± 0.4 ab	1.8 ± 0.3 a	16.0 ± 1.1 a	0.22 ± 0.08 d	74.4
IR[h]	5.0 ± 0.5 ab	1.6 ± 0.5 a	15.9 ± 2.5 a	0.18 ± 0.01 cd	89.7
GL[i]	5.4 ± 0.3 ab	1.5 ± 0.6 a	15.7 ± 0.7 a	0.13 ± 0.04 c	121.3

Lippens; [b] Sensation; [c] Osteen; [d] Tommy Atkins; [e] Kensington; [f] Palmer; [g] Valencia Pride, [h] Irwin, [i] Gleen. Average ± Standard deviation. Different letters within the same column represent the statistical difference (LSD, P< 0.05).

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apparently due to change in structure of the pectin polymers in the cell wall during the ripening process (Kalra *et al*., 1995). The maximum textural firmness was observed as 2.7 kg m^{-2} when the TSS content was 20º Brix with *cv.* Lippens. Texture is one of the important quality parameters which plays a significant role in fruit selection by the consumer.

Table 3 shows some other important characteristics for the cultivars studied: fruit shape, skin colour, pulp colour, skin-pulp adherence, and fibre availability. With the exception of *cvs.* Kensington and Palmer, most of the cultivars dealt with in the present study were low in fibre, in agreement with Calatrava *et al.* (1996), the European consumers preferring fruits with this feature.

A great part of the production is exported mainly to the Netherlands, France, Germany, the United Kingdom, and Belgium. Thus, the characterization of the Spanish fresh mango fruit grown in the subtropical region of the Granada coast is crucial, in order to compete in the EU market. Moreover, the fruit yields in the study zone can be compared with those in the fully tropical areas, due to the high density plantations within orchard terraces (600 tree ha^{-1}, with an average commercial fruit yield of 15 kg $tree^{-1}$) (Table 1). In addition, Spanish mango cultivation could have benefit from market trends: on the one hand, the organic-production system is one with the highest potential along with the greatest demand by EU countries, providing opportunities for small-size farming. At present, the organic mango orchards in Granada are still nonexistent. Secondly, it is vital to establish market diversification—that is, to create new small- and medium-size industries dedicated to making mango added-value products. Since subtropical fruit farming is one of the main economic activities on the Granada coast, these two new possible trade opportunities for Spanish mango fruits could help the economy, which is steadily more unbalanced in favour of tourism, a trend causing a negative impact on the coastal environment.

It is concluded that a combination of a number of physico-chemical fruit parameters is employed to specify the quality of mango fruits. The results of the present experiment indicate that most of the Florida mango cultivars studied in this subtropical marginal area (the Granada coast of southern Spain) met the standard parameters for considering the fruit to be of high quality, especially *cvs.* Osteen and Tommy Atkins. Therefore, mango cultivation in south-eastern Spain offers promising possibilities for exporting high-quality fresh fruits, especially because of the vicinity to other EU countries.

ACKNOWLEDGEMENTS

Table 3. Fruit organoleptic characteristics at maturity stage for each mango cultivars studied.

	Visual and organoleptic characteristic				
Mango cultivars	Fruit shape	Skin colour	Pulp colour	Adherence skin-pulp	Fibre presence
LI[a]	Oval	Yellow-Pink	Yellow	Medium	Low
SE[b]	Oval	Purple	Orange	Medium	Low
OS[c]	Ovoid	Red-purple	Orange	Medium	Low
TA[d]	Ovoid-oval	Red	Orange	Medium	Low
KE[e]	Ovoid-oblique	Green-yellowish	Yellow-range	Low	Medium
PA[f]	Oval	Yellow-orange	Orange	Medium	Medium
VP[g]	Ovoid-kidney	Yellow-orange	Orange	Medium	Low
IR[h]	Ovoid	Red-orange	Yellow	Medium	Low
GL[i]	Ovoid	Red-purple	Yellow	Medium	Low

[a] Lippens; [b] Sensation; [c] Osteen; [d] Tommy Atkins; [e] Kensington; [f] Palmer; [g] Valencia Pride, [h] Irwin, [i] Gleen.

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پارامترهای فیزیکی- شیمیایی کیفی میوه ی انبه (*Mangifera indica* L.) پرورش یافته در آب و هوای نیمه گرمسیری مدیترانه ای جنوب شرقی اسپانیا

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چکیده

تولید انبه در نواحی مختلف نیمه گرمسیری در سرتاسر دنیا در حال گسترش است. کاشت این درخت میوه در طول سواحل گرانادا، جائی که در حال حاضر در آنجا ۱۵۰۰ هکتار زیر کشت این محصول است، مقرون به صرفه می‌باشد. اتحادیه اروپا در سال ۲۰۰۶ میزان ۱۱۸ هزار تن انبه به ارزش ۱۳۱ میلیون یورو را صادر نموده است. این مطالعه به منظور برآورد خصوصیات کیفی فیزیکی شیمیائی پاره‌ای از میوه‌ای انبه که در شرایط آب و هوائی نیمه گرمسیزی مدیترانه‌ای در اسپانیا به ثمر می‌رسد صورت گرفت. تعداد بیست و پنج عدد میوهٔ انبه از تعداد هشت کولتیوار فلوریدائی و یک کولتیوار استرالیائی (از درختان مختلف) در مرحلهٔ قبل از رسیدگی کامل (میوهٔ سبز و سفت) جمع‌آوری و وزن شدند. میوه‌های کالتیوار استین

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(Osteen) دارای بیشترین وزن (۹۵ ± ۶۹۷ گرم) و نسبت به گوشت به هستهٔ آنها (۲: ۲۰) به میزان قابل ملاحظه‌ای بیشتر از سایر کلتیوارهای مورد آزمایش بود کمترین نسبت بین گوشت و هسته در مورد کلتیوارهای کنسینگون (Kensington) (۶/۳) و یسن شی شن (Sentation) (۷/۶) به ثبت رسید. میوه‌های داریا بیشترین گوشت میوه به کلتیوارهای گلین، پالمر و استین (Gleen, Palmer, Osteen) متعلق بودند که متوسط گوشت میوه در مورد هر کدام از آنها ۸۵ درصد از وزن میوه بود. وزن هستهٔ میوه‌های کلتیوار استین کمترین میزان (۴/۲٪) را در بین تمامی کلتیوارها به خود اختصاص داد که مؤید مطلوب‌ترین نسبت وزن هسته به گوشت میوه بود. کلتیوار والنسیا پراید (Valencia Pride) دارای بیشترین اسیدتیه (۰/۲۲٪) بود در حالیکه لینس (Lippens) بیشترین مقدار کل محلول‌های جامد (Total soluble solids) را در برداشت. نسبت‌های کل محلول‌های جامد به اسیدیتهٔ کل در مورد کلیتوارهای کنت (Kent) (۱۳۸۲) و لیپنس (۳۳۳) بیشترین مقادیر را به خود اختصاص داده که ممکن است نمایانگر تأثیر این عامل بر روی طعم میوه باشد. تمامی کلتیوارهای انبه در این ناحیهٔ حاشیه‌ای نیمه‌گرمسیری، خصوصاً کلتیوارهای استین و تومی اتکینس (Tommy Atkins) دارای مشخصات استاندارد میوهٔ با کیفیت بالا را دارا بودند و می‌توان آنها را بواسطهٔ محصول قابل قبول و عملکرد متوالی و دوام دار در یک این‌چنین محیط‌هائی توصیه نمود.

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