Quality comparison of conventionally and organically grown oranges in Spain

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Introduction

Intensive orange production using mineral fertilizers and pesticides may cause environmental damage in citrus orchards, mainly with respect to groundwater contamination, an important aspect of process quality. Likewise product quality may be affected by agricultural inputs, in particular by mineral fertilizers. Both, high product and process quality are key criteria for the successful marketing of organic products such as oranges. We assessed a range of physical and chemical parameters in juice of oranges from different origin (organic and conventional production) harvested and and stored for different time.

Materials und Methods

Samples were taken from both a certified organic (ORG) and a conventional (CON) orchard (700 m distance) in the La Safor Valley, Gandia, close to Valencia, Spain (picture 1).

Picture 1: La Safor Valley, Gandia, organic orchard

The site is characterized by fertile calcareous loamy clay soils (> 30% Ca CO_3, pH = 7,5 - 8) and mild weather conditions (average annual tempera ture = 17° C).

Oranges (cv. Navelina) were harvested at different dates (either November or December 2008) and stored for either 0, 1 or 2 months. In total 640 oranges (320 ORG and 320 CON) were analysed one by one following a systematic sampling procedure over 4 blocks (4 fruits per tree * 4 trees = 1 block, see fig 1).

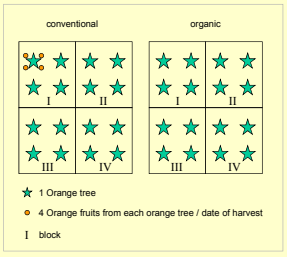

Figure 1: Sampling method in orange orchards

A wide range of fruit physical and chemical parameters including weight and size, proportion of juice, Brix value, ascorbic acid and mineral content were measured according to standard techniques at the lab of the ETSMR in Valencia.

Data were submitted to ANOVA with subsequent Tukey-Test using a statistical model with repeated measurements.

Results

Conventionally compared to organically grown oranges had a significantly higher weight (224 vs. 204 g), a significantly larger height and a slightly higher diameter (table 1).

The relative skin proportion was significantly lower in ORG (24,3%) compared to CON (26,7%), while the juice and pulp proportion from oranges of both growing systems were equal (table 2). Earlier compared to later harvested oranges had a higher juice proportion.

Parameter	Growing system		Date of harvest	
	CON	ORG	NOV	DEC
Weight (g)	224.3 a	203.7 b	207.6 b	220.8 a
Height (mm)	78.5	76.7	76.6 b	78.6 a
Diameter (mm)	77.4	74.6	75.3	76.8

Table 1: Effect of growing system and harvest date on physical parameters of oranges, cv. Navelina, Tukey-Test, α = 0,05.

	Growing system		Date of harvest		Storage time (month)		
	CON	ORG	NOV	DEC	0	1	2
Skin (%)	26.7 a	24.3 b	24.7 b	26.4 a	24.3	25	25.1
Juice (%)	43.4	43.5	44.7 a	42.3 b	47.4	42.9	41.8
Pulp (%)	29.9	32.4	30.6	31.4	28.3	32.1	33.2

Table 2: Effect of growing system, harvest date and storage time on the relative proportion (%) of skin, juice and pulp of oranges, cv. Navelina, Tukey-Test, α = 0,05.

The soluble dry matter and the citric acid content of the juice were not affected by the growing system (table 3). In contrast the L-ascorbic acid content was significantly higher in ORG compared to CON orange juice (652 vs. 584 ppm). The potassium and magnesium (significant) content of orange juice tended to be higher in ORG, while the phosphorous (significant) and calcium contents were higher in CON.

	Growing system		Date of harvest		Storage time (month)		
	CON	ORG	NOV	DEC	0	1	2
Soluble d.m. (%)	9.3	10.6	9.7 b	10.2 a	9.8	9.9	9.6*
Citric acid (%)	2	2.4	2.3 a	2.1 b	2.4	2.3	2.1*
Maturity index	5.1 a	4.8 b	4.8 b	5.2 a	4.3 b	4.6 b	5.3 a
Ascorb.acid ppm	584b	652a	607b	627a	609	633	605

Table 3: Quality profile of orange juice cv. Navelina as affected by growing system, date of harvest and storage timeTukey-Test, α = 0,05.

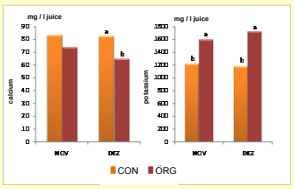

Figure 2: Effect of growing system and harvest date on the calcium and potassium content of orange juice, cv. Navelina, Tukey-Test, α = 0,05.

As expected, later harvesting of the fruits resulted in a significant increase of soluble dry matter and ascorbic acid content as well as of the maturity index, while the citric acid content was significantly lower.

Conclusions

All in all our data suggest that differences in the amount of beneficial compounds are not a key criteria for quality distinction of different growing systems, probably because they mainly depend on the variable fertilization regimes. Other important quality traits such as the amount of harmful compounds were not assessed in our experiment, but it is clear and evident that in general the amount of pesticide residues is much lower in organic compared to conventional oranges.

Moreover, there is some evidence that the process quality, which includes environmental impact categories such as groundwater contamination, biodiversity and soil erosion, is considerably higher under organic management.

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