

**The content of bioactive
compounds in organically and
conventionally produced fresh
tomato and tomato juices**





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Tomato cultivars for experiment in 2006



cv. Rumba



cv. Kmicic



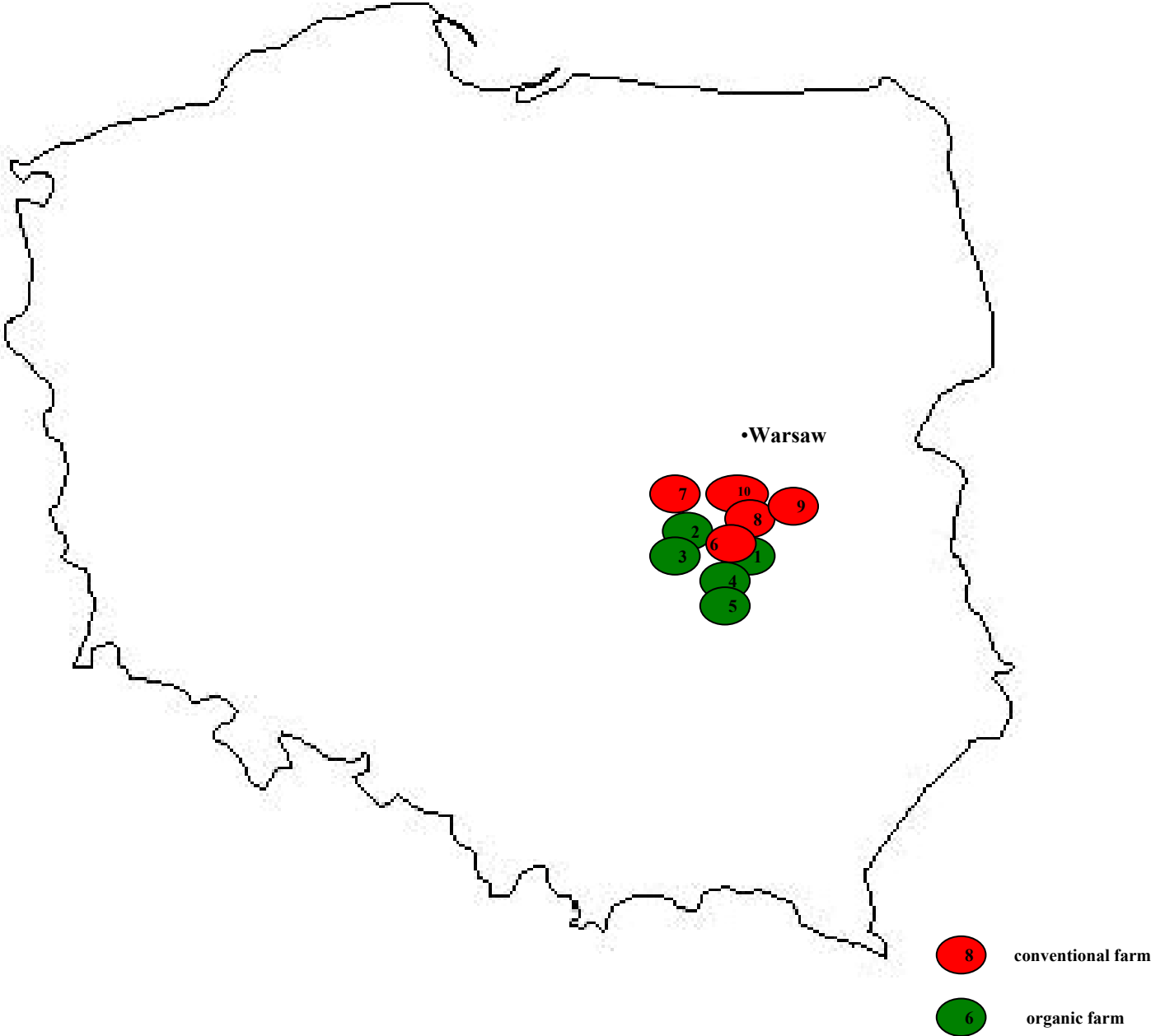
cv. Gigant



cv. Koralik

- dry matter PN-90 A 75101/03
- vitamin C (PN-90 A 75101/11)
- total flavonols (quercetin) (Strzelecka i in. 1978)
- carotenoids: lycopene and beta-carotene (Saniawski i Czapki 1983)
- total phenolic acids (Farmakopea Polska wyd. VI 2002)

Location of the organic and conventional farms producing tomatoes

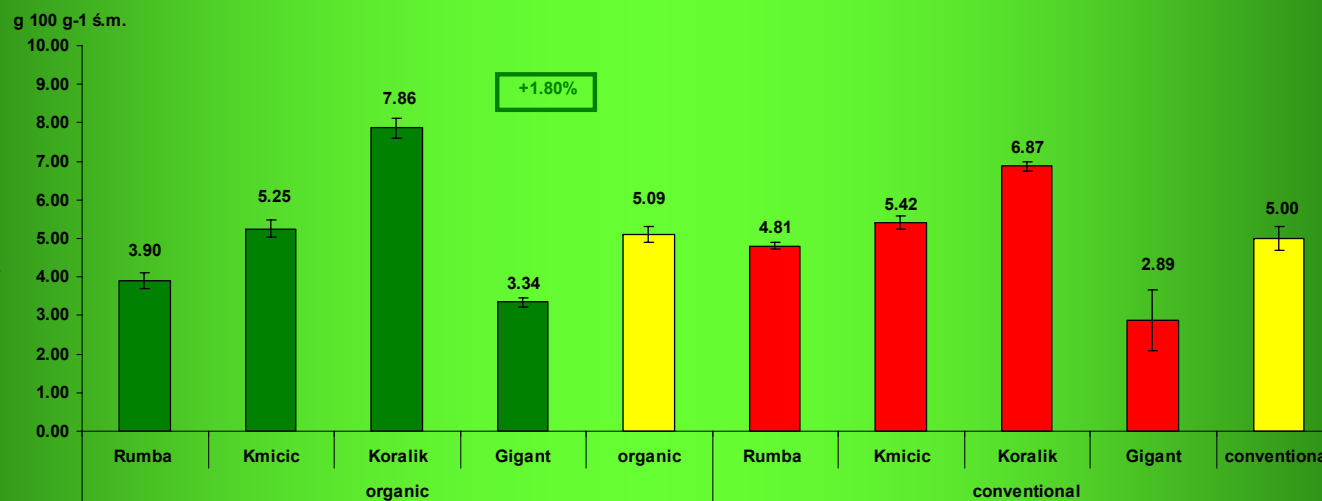


Fertilization and plant protection in organic and conventional farms (experiment with fresh tomato and tomato juices)

fertilization balance

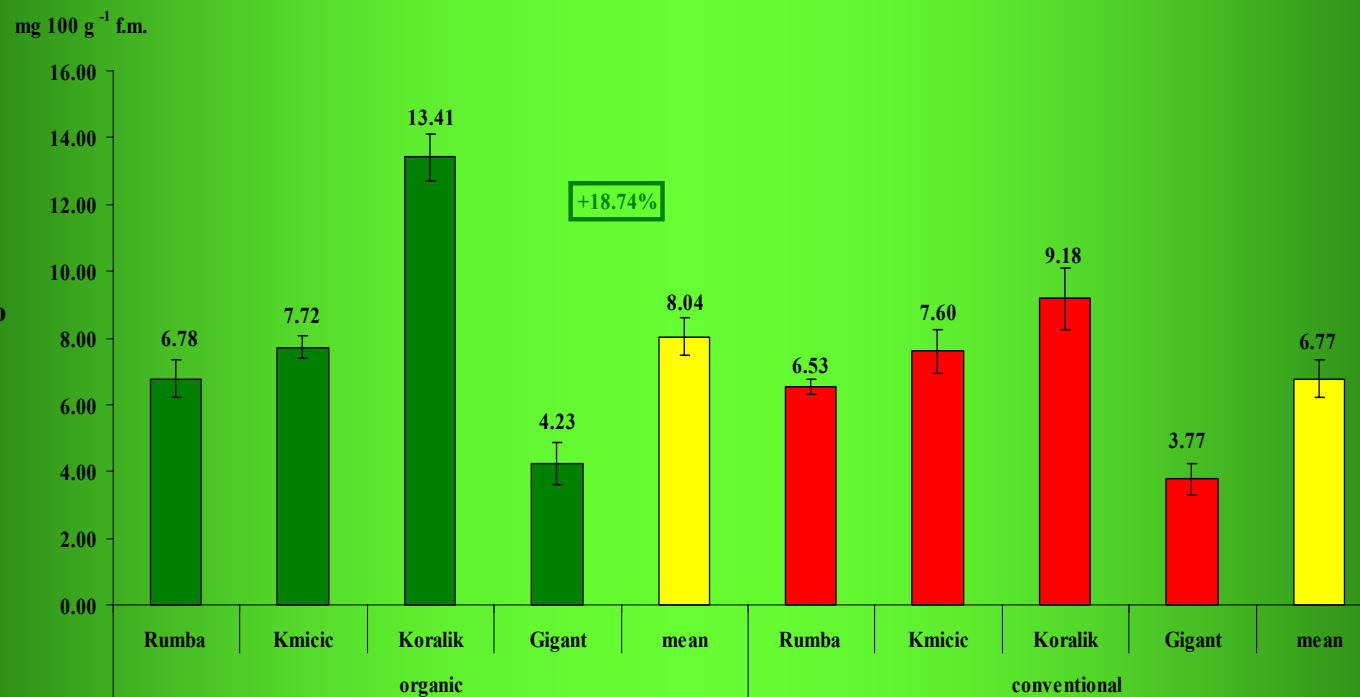
| | localization | fertilization rate and plant protection | N kg/ha | P kg/ha | K kg/ha | Mg kg/ha | Ca kg/ha | microelements |
|--------------------------------|--|---|------------|------------|------------|-------------|-------------|---------------|
| organic farm no. 1 | Kaszewska Wola /51°30' N 20°55' E/ | green manure patentkali basaltic flour Bioczos BR, Antifung 20SL | 180 | 0 | 310 | 143 | 215 | tak |
| organic farm no. 2 | Radzanów /52°56' N 20°05' E/ | compost 60% humovit nettle slurry | 160 | 49 | 133 | ? | ? | ? |
| organic farm no. 3 | Sukowska Wola /51°29' N 20°57' E/ | cow manure (20 t/ha) slurry no plant protection | 106 | 21 | 112 | 85 | 20 | nie |
| conventional farm no.4 | Kaszewska Wola /51°19' N 20°58' E/ | cow manure (20 t/ha) poly-feed Nemrod 25 EC, Karate Zeon 050 SC | 163 | 110 | 155 | 327 | 14 | tak |
| conventional farm no. 5 | Sewerynów /51°28' N 20°54' E/ | polidap polimag ammonium nitrate calcium nitrate Sumilex 500 S.C., Nurelle 500 S.C., Topsin 500 SC | 185 | 142 | 6,25 | 70 | 15 | tak |
| conventional farm no. 6 | Orońsko /51°18' N 20°59' E/ | potassium sulphate phosphorus in pellets alkalin P-K 5-25% Miedzian 50 WP, Brawo 500 SC | 220 | 60 | 290 | 60 | 120 | tak |

Rys. 1. Content of dry matter in tomato fruits from organic and conventional production



p-value
cultivation n.s.
variety <0.0001
interaction 0.0007

Rys. 2. Content of vitamin C in tomato fruits from organic and conventional production



p-value
cultivation <0.0001
variety <0.0001
interaction <0.0001

Thybo et al. 2006 LWT 39, 835-843.

| | 2002 | | | 2003 | | |
|-----------------------------|---------|--------------|-----------------|---------|--------------|-----------------|
| | organic | conventional | % of difference | organic | conventional | % of difference |
| Dry matter (g/100 g.f.m.) | 6.04 a | 5.64 a | 7.09% | 5.87 a | 5.67 a | 3.52% |
| Vitamin C (mg / 100 g.f.m.) | 15.00 a | 11.80 a | 27.12% | 16.0 ab | 14.6 a | 9.58% |

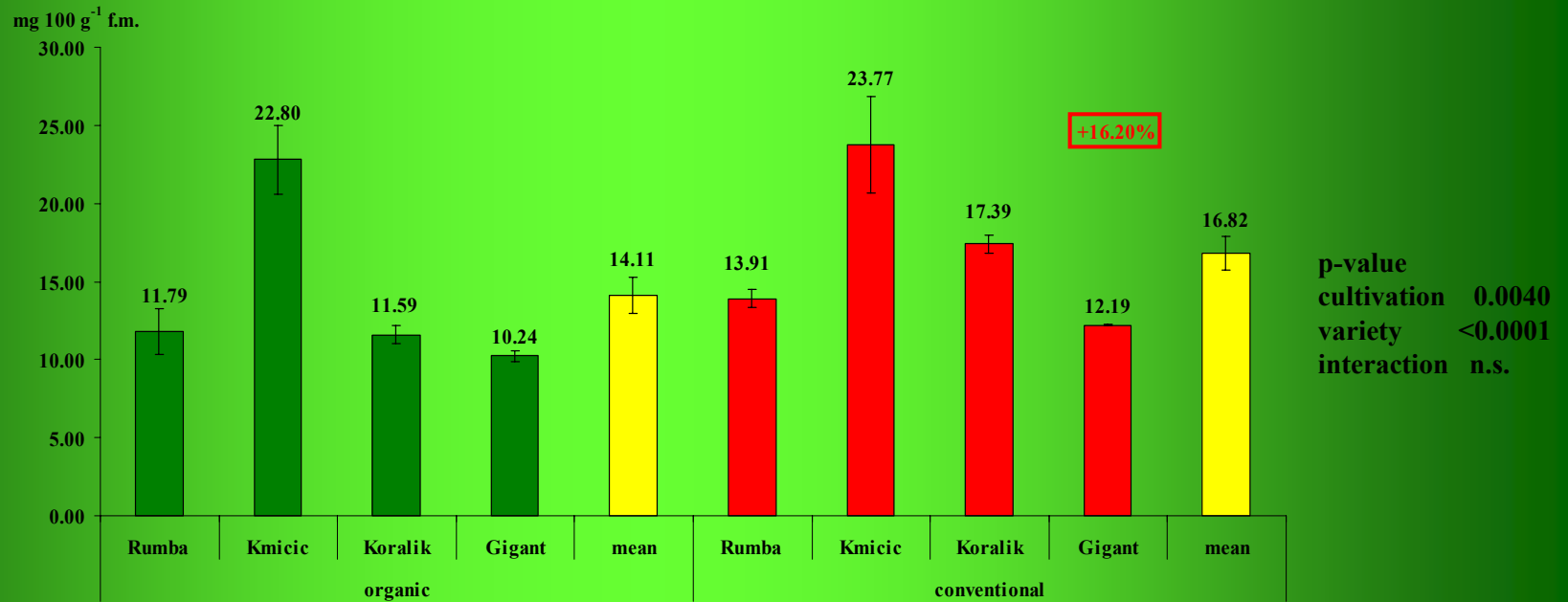
Different letters within rows at each year indicate significant differences at p=0.05

Toor et al. 2006 J. Food Comp Anal. 19, 20-27

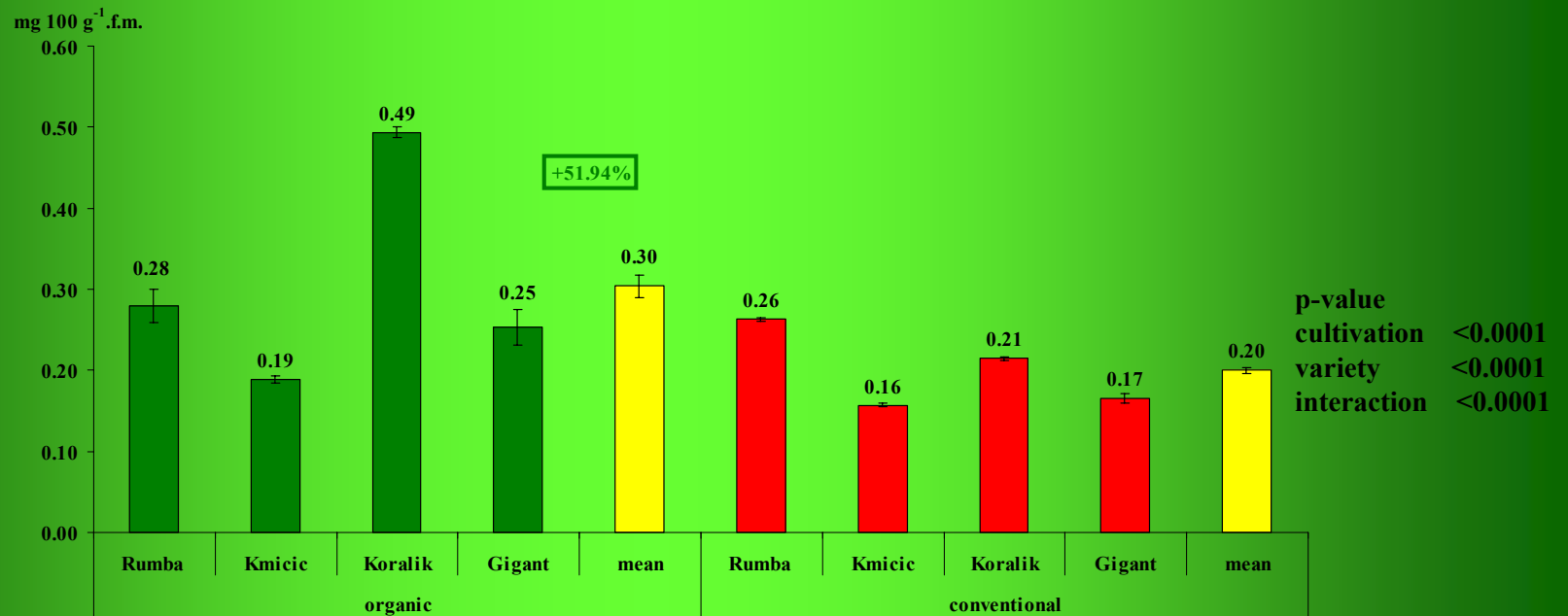
| | 2002 | | |
|-----------------------------|---------|--------------|-----------------|
| | organic | conventional | % of difference |
| Dry matter (g/100 g.f.m.) | 6.01 a | 6.00 a | 0,16% |
| Vitamin C (mg / 100 g.f.m.) | 15.00 b | 11.80 a | 27,12% |

Different letters within rows at each year indicate significant differences at p=0.05

Rys. 3. Content of lycopene in tomato fruits from organic and conventional production



Rys. 4. Content of beta-carotene in tomato fruits from organic and conventional production



Caris-Veynart et al. 2004 J. Agric Food Chem 52, 21, 6503-6509

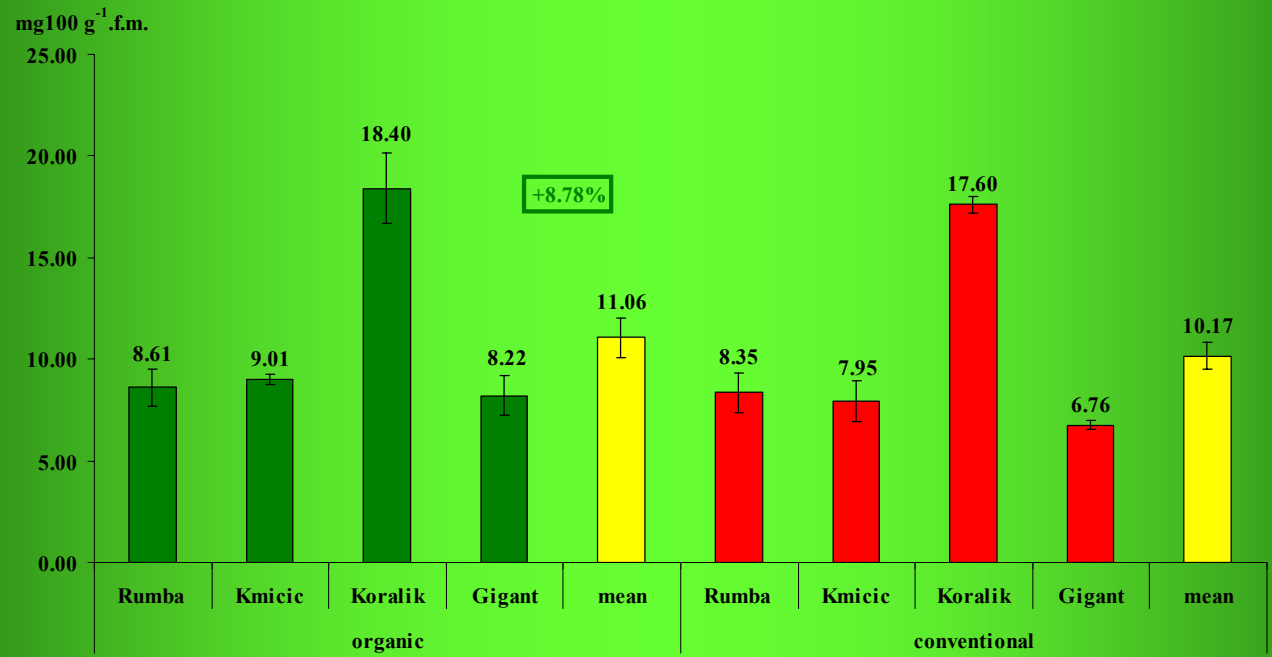
| | Felicia | | | Izabela | | | Paola | | |
|------------------------------|---------|-------|------------------|--------------------------------|-------|------------------|---------|-------|------------------|
| | org. | conv. | % of differences | org. | conv. | % of differences | org. | conv. | % of differences |
| lycopene (mg/100g.f.m.) | 4.20 | 3.80 | 10.52% | 3.60 | 3.20 | 12.5% | 4.10 | 3.40 | 20.58% |
| beta-carotene (mg/100g.f.m.) | 1.31 | 0.92 | 42.39% | 1.03 | 0.86 | 19.76% | 1.35 | 0.83 | 62.65% |
| p-value (lycopene) | | | | p-value (beta-carotene) | | | | | |
| cultivation | <0.0001 | | | cultivation | | | <0.0001 | | |
| variety | <0.0001 | | | variety | | | n.s. | | |
| interaction | n.s. | | | interaction | | | n.s. | | |

Toor et al. 2006
J. Food Comp. Anal. 19, 20-27

| | 2002 | | % of differences |
|-------------------------|---------|--------------|------------------|
| | organic | conventional | |
| lycopene (g/100 g.f.m.) | 18.30 a | 20.80 ab | 13.66% |

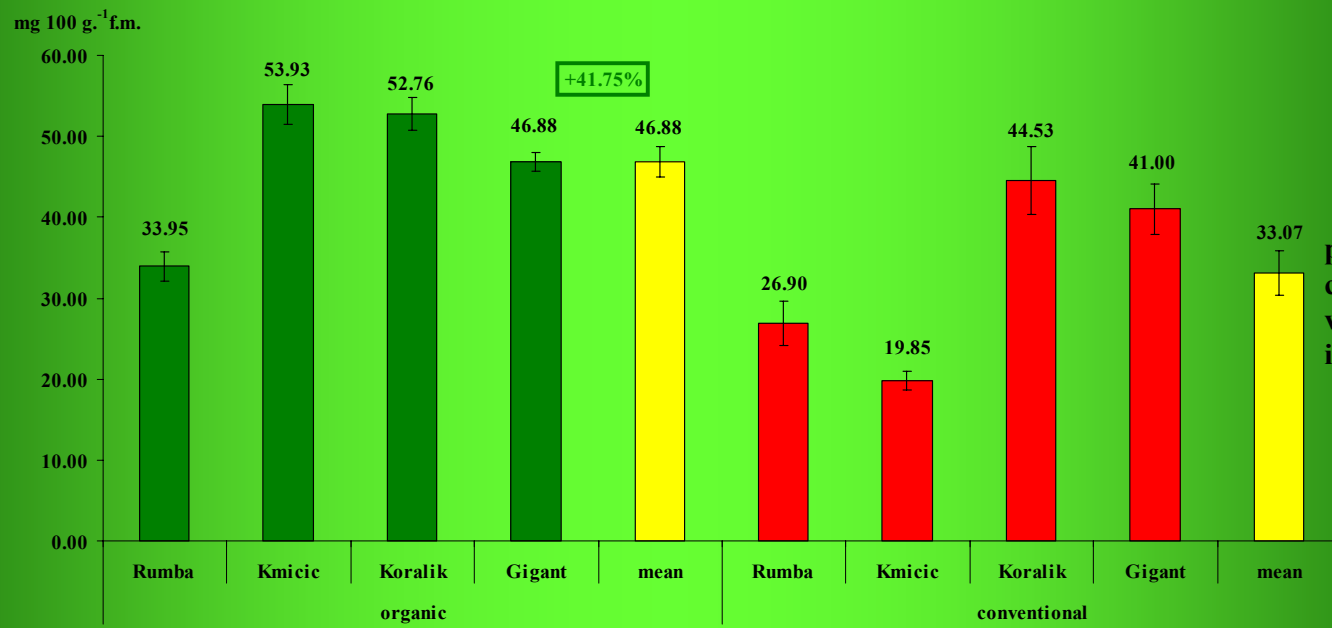
Different letters within rows at each year indicate significant differences at p=0.05

Rys. 5. Content of flavonols in tomato fruits from organic and conventional production



p-value
 cultivation 0.0300
 variety <0.0001
 interaction n.s.

Rys. 6. Content of phenolic acids in tomato fruits from organic and conventional production



p-value
 cultivation <0.0001
 variety <0.0001
 interaction <0.0001

Caris-Veynart et al. 2004 J. Agric Food Chem. 52, 21, 6503-6509

| | Felicia | | | Izabela | | | Paola | | |
|------------------------------|-------------|-------|------------------|-----------------------------|-------|------------------|-------------|-------|------------------|
| | org. | conv. | % differences | org. | conv. | % differences | org. | conv. | % differences |
| rutin (mg/100g.f.m.) | 0.18 | 0.15 | 20% | 0.22 | 0.04 | 450% | 0.14 | 0.10 | 40% |
| naringenin (mg/100g.f.m.) | 0.10 | 0.08 | 25% | 0.09 | 0.080 | 12.5% | 0.09 | 0.09 | - |
| p-value (rutin) | | | | p-value (naringenin) | | | | | |
| cultivation | <0.0001 | | | cultivation | | | <0.0001 | | |
| variety | <0.0001 | | | variety | | | n.s. | | |
| interaction | <0.0001 | | | interaction | | | <0.05 | | |

Caris-Veynart et al. 2004 J. Agric Food Chem. 52, 21, 6503-6509

| | Felicia | | | Izabela | | | Paola | | |
|-----------------------------------|----------------|--------------|----------------------|----------------|--------------|----------------------|--------------|--------------|----------------------|
| | org. | conv. | % differences | org. | conv. | % differences | org. | conv. | % differences |
| chlorogenic acid (mg/100g.f.m.) | 0.55 | 0.64 | -16.36% | 0.18 | 0.17 | 5.88% | 0.14 | 0.10 | 40.0% |
| p-value (chlorogenic acid) | | | | | | | | | |
| cultivation | <0.0001 | | | | | | | | |
| variety | <0.0001 | | | | | | | | |
| interaction | 0.0001 | | | | | | | | |

**Toor et al. 2006
J. Food Comp Anal. 19, 20-27**

| | 2002 | | |
|-----------------------------------|----------------|---------------------|------------------------|
| | organic | conventional | % of difference |
| Soluble phenolics (mg/100 g.f.m.) | 442 a | 409 a | 8,06% |

Different letters within rows at each year indicate significant differences at p=0.05



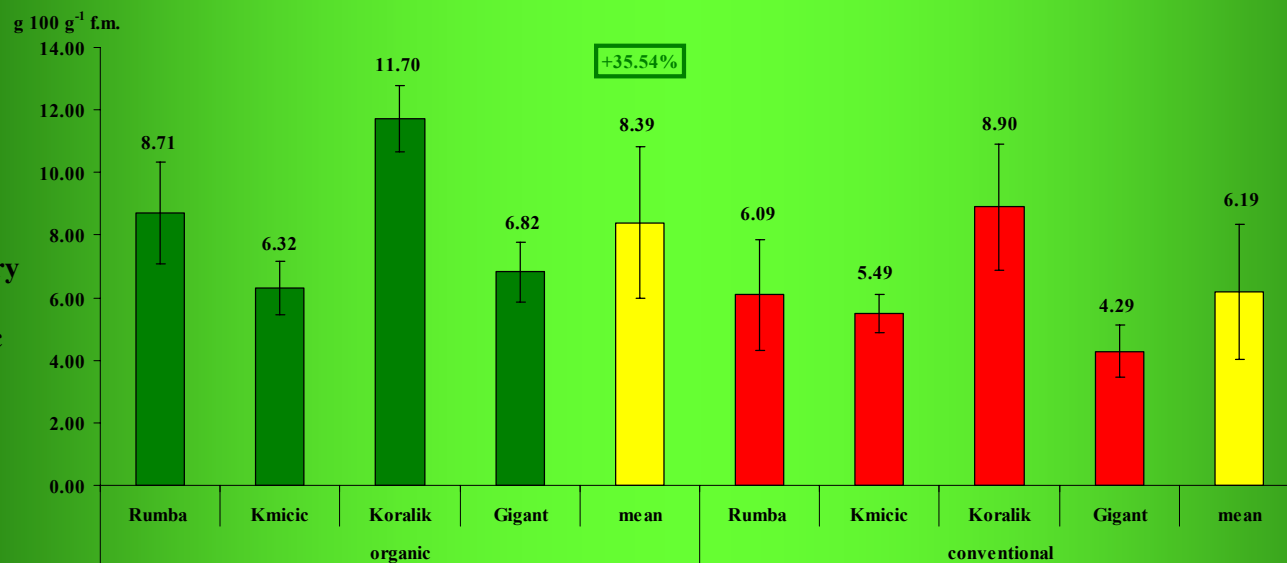
Sensory analysis of tomato juices

- **odours:** tomato-like, sweet, sour, pungent, other
- **flavour:** tomato-like, sweet, pungent, bitter and other
- **colour,** feeling of pieces, density
- overall quality

Chemical analysis of tomato juices

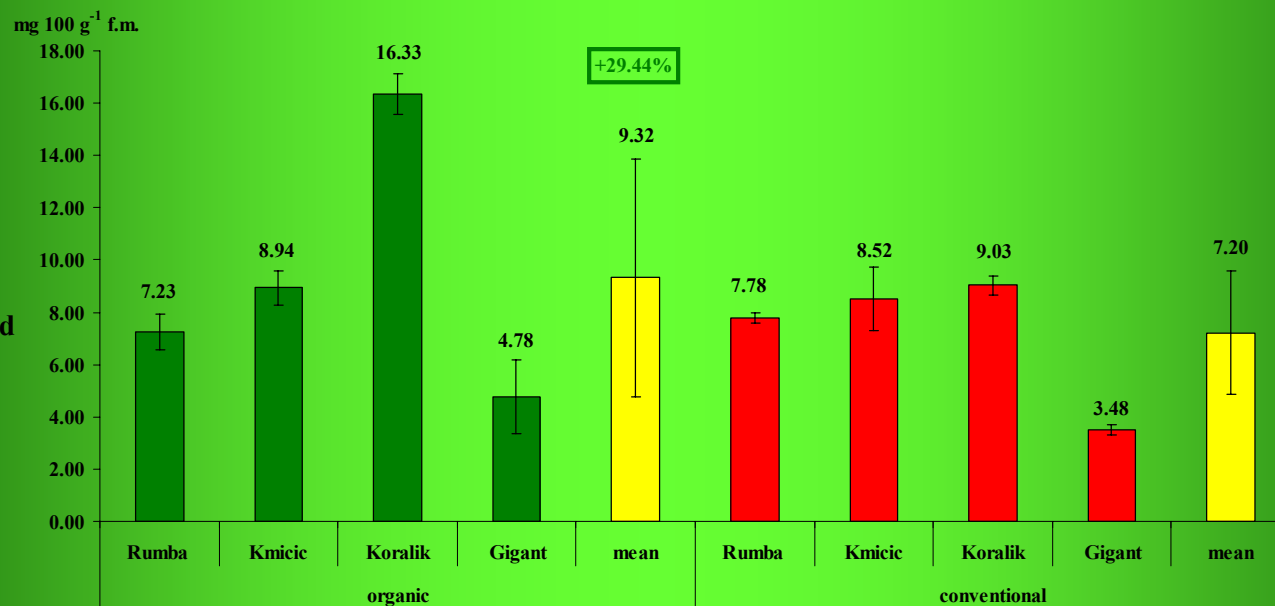
dry matter PN-90 A 75101/03
vitamin C (PN-90 A 75101/11)
total flavonols (Strzelecka i in. 1978)
carotenoids: lycopene and beta-carotene
(Saniawski i Czapki 1983)
total phenolic acids
(Farmakopea Polska wyd. VI 2002)

Rys. 7. Content of dry matter in tomato juices from organic and conventional production



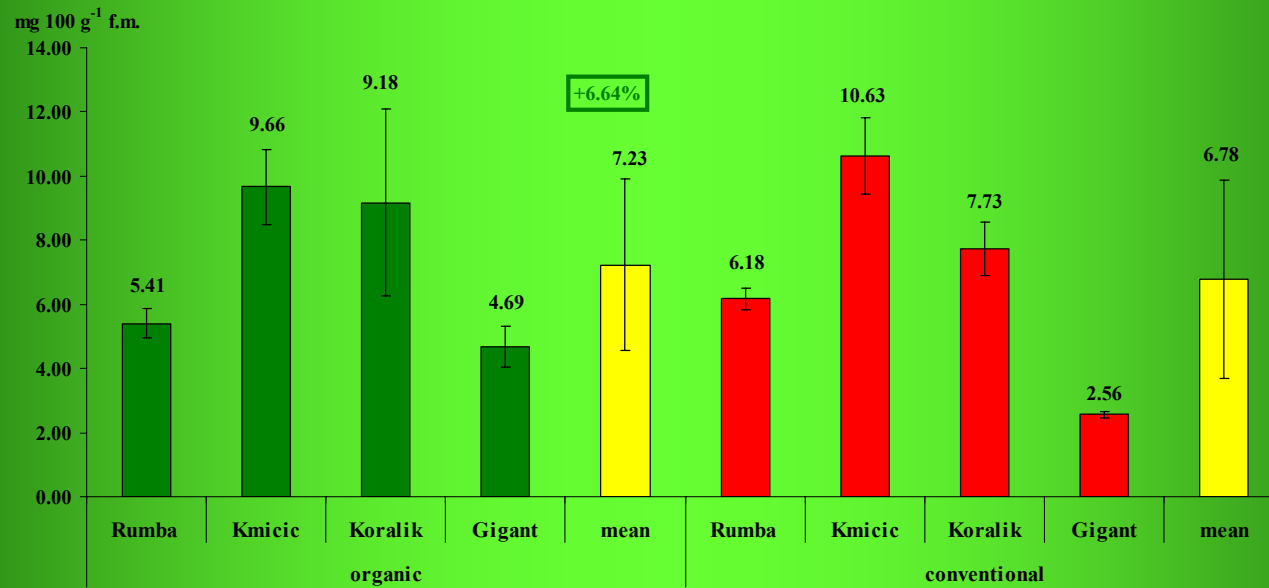
p-value
 cultivation <0.0001
 variety <0.0001
 interaction 0.0028

Rys.8. Content of vitamin C in tomato juices from organic and conventional production



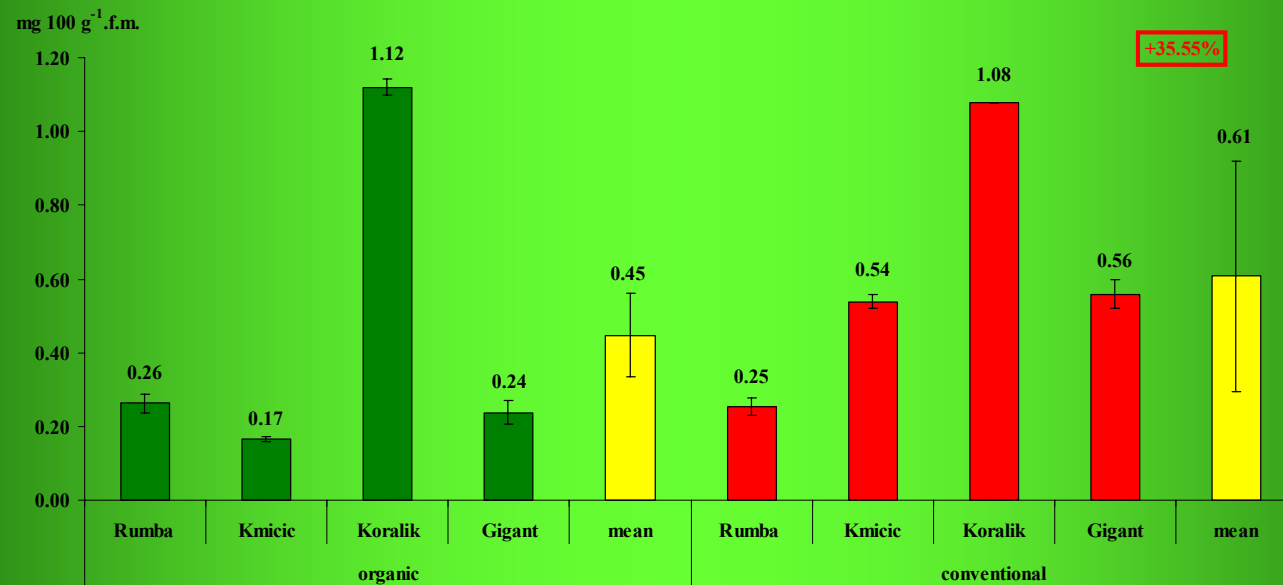
p-value
 cultivation <0.0001
 variety <0.0001
 interaction <0.0001

Rys. 9. Content of lycopene in tomato juices from organic and conventional production



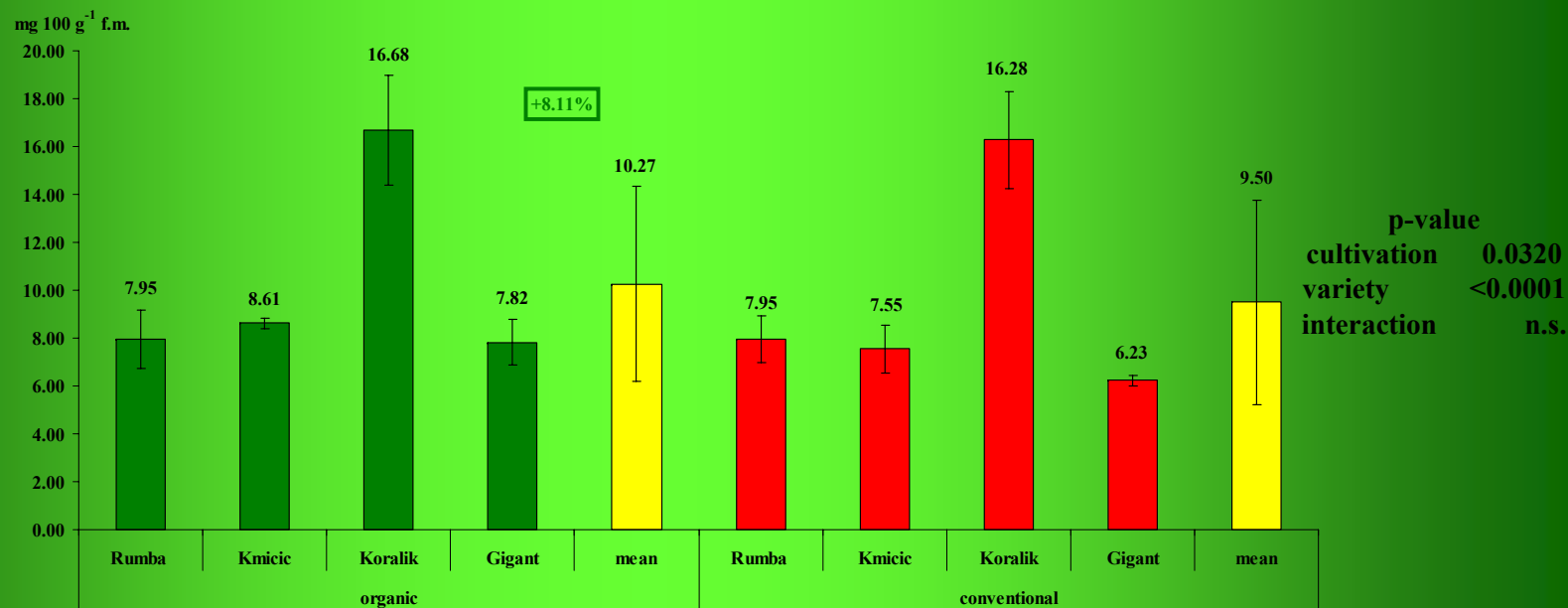
p-value
 cultivation <0.0001
 variety <0.0001
 interaction 0.0028

Rys. 10. Content of beta-carotene in tomato juices from organic and conventional production

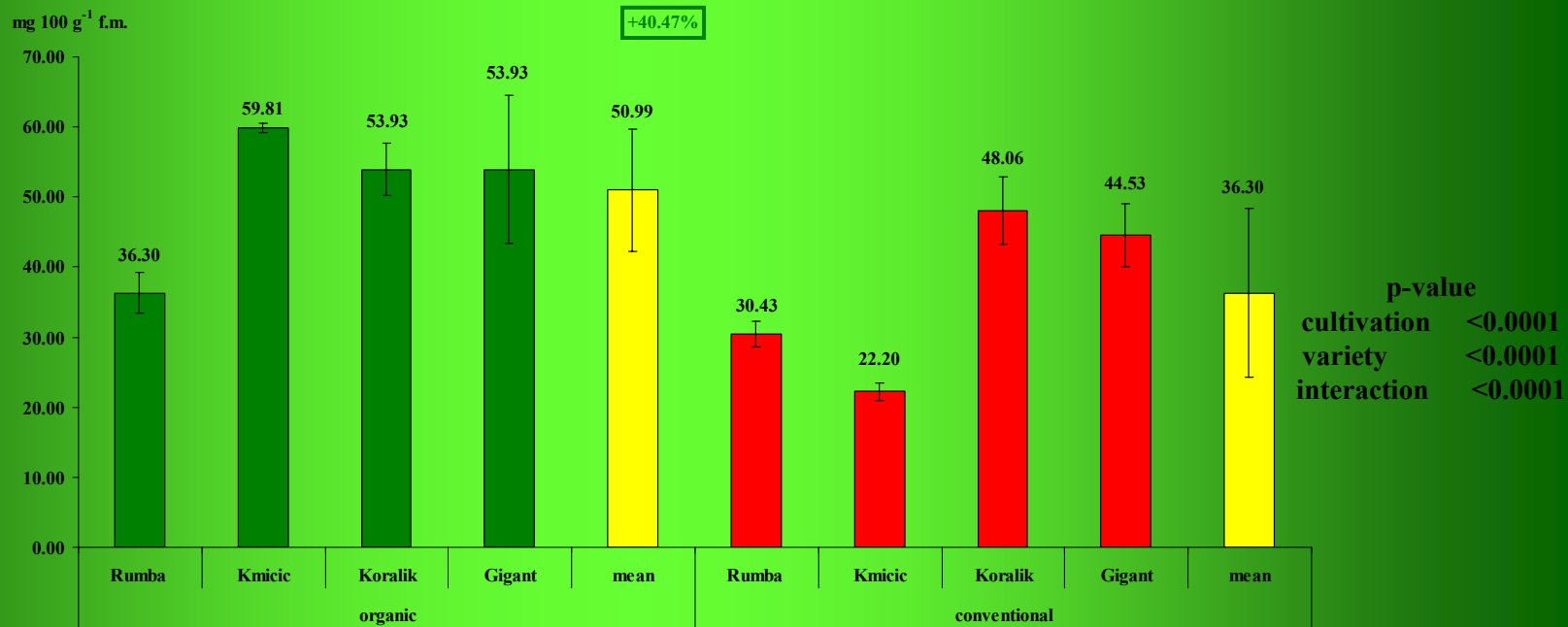


p-value
 cultivation <0.0001
 variety <0.0001
 interaction <0.0001

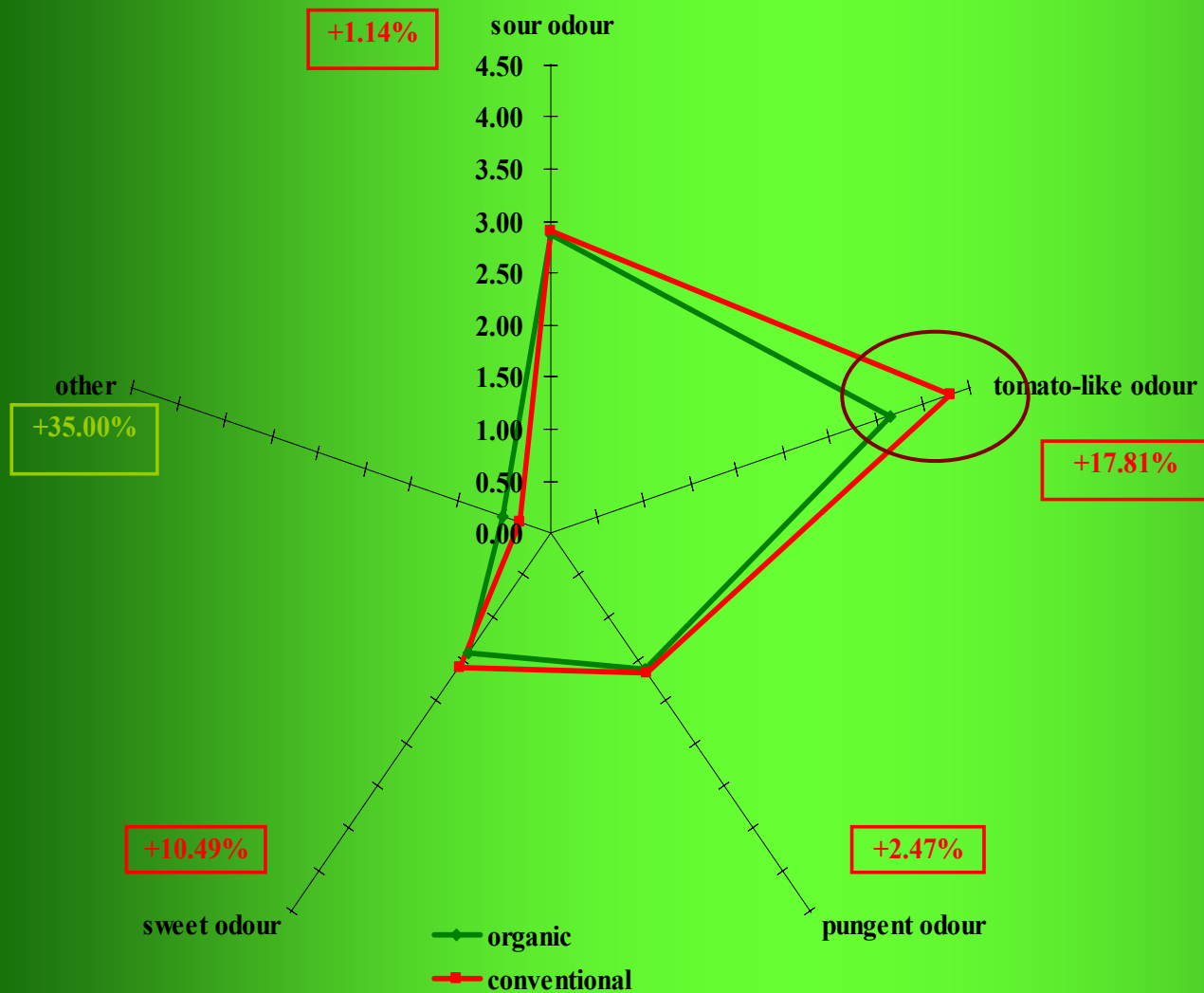
Rys. 11. Content of flavonols in tomato juices from organic and conventional production



Rys. 12. Content of phenolic acids in tomato juices from organic and conventional production



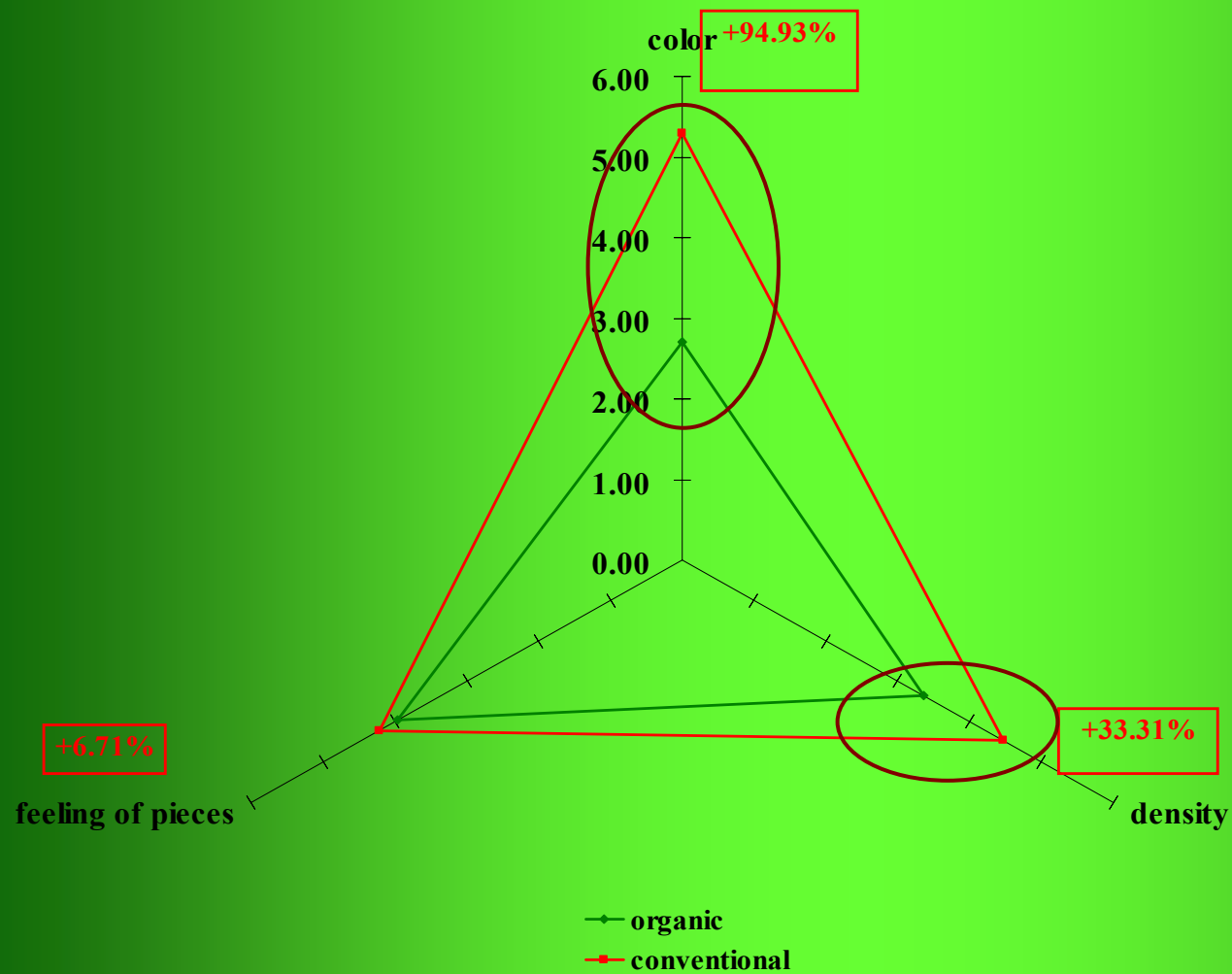
Rys. 13. Sensory analyses of selected odours of tomato juices



2006
p-value (sour odour)
 cultivation n.s.
 variety n.s.
 interaction n.s.
p-value (tomato-like)
 cultivation 0.001
 variety 0.004
 interaction n.s.

2006
p-value (pungent odour)
 cultivation n.s.
 variety n.s.
 interaction n.s.
p-value (sweet odour)
 cultivation n.s.
 variety n.s.
 interaction n.s.
p-value (other odour)
 cultivation n.s.
 variety 0.001
 interaction <0.0000

Rys. 14. Sensory analyses of selected textural attributes of tomato juices

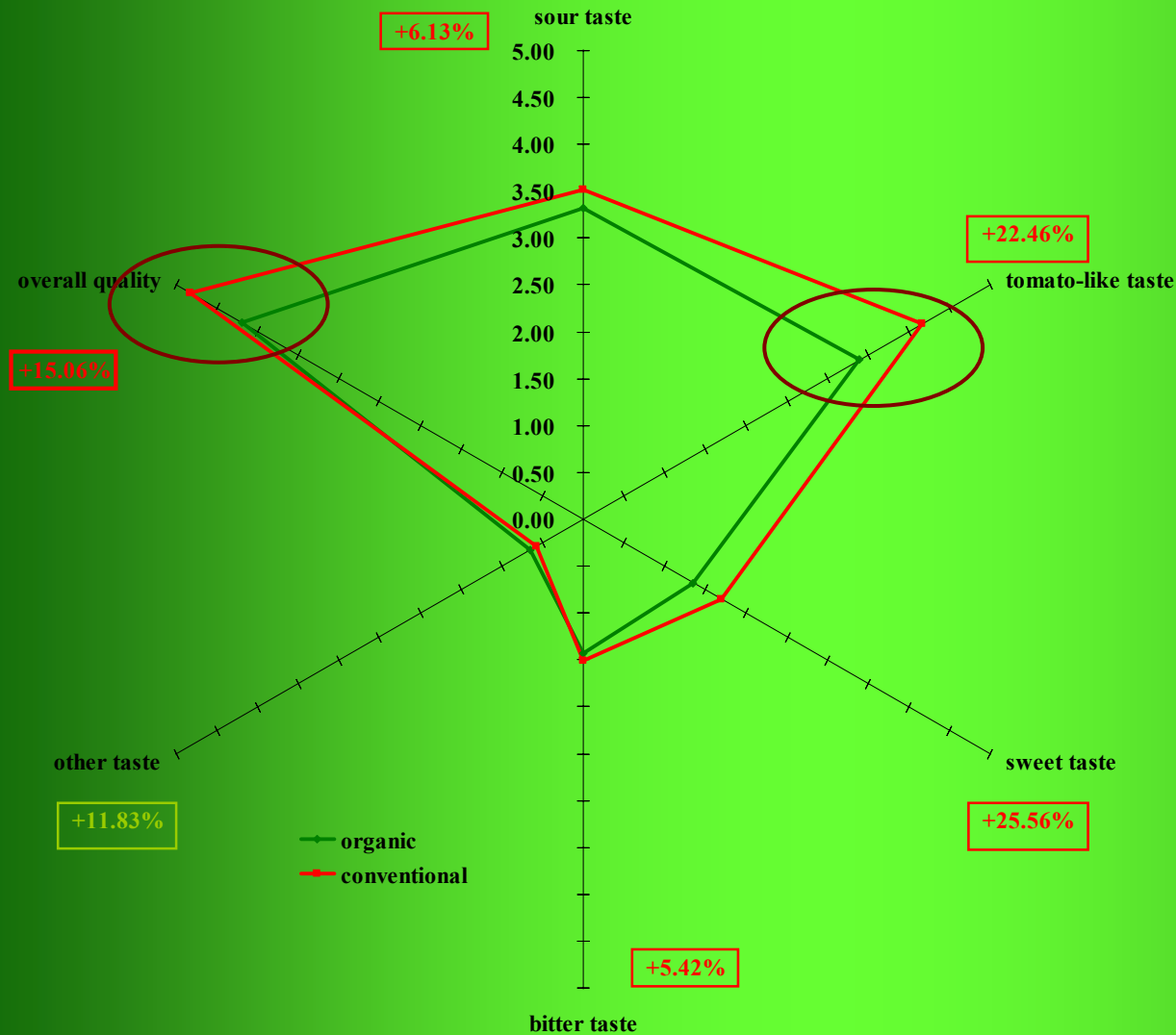


2006
p-value (colour)
 cultivation <0.0001
 variety n.s.
 interaction n.s.

p-value (density)
 cultivation <0.0001
 variety <0.0001
 interaction <0.0001

p-value (feeling of pieces)
 cultivation n.s.
 variety <0.0001
 interaction <0.0001

Rys. 15. Sensory analyses of selected taste of tomato juices



2006

p-value (sweet taste)
 cultivation n.s.
 variety n.s.
 interaction n.s.

p-value (bitter taste)
 cultivation n.s.
 variety <0.0001
 interaction <0.0001

p-value (overall quality)
 cultivation 0.0018
 variety <0.0001
 interaction <0.0001

p-value (sour taste)
 cultivation n.s.
 variety <0.0001
 interaction <0.0001

p-value (tomato-like taste)
 cultivation 0.0020
 variety 0.0050
 interaction 0.0120

p-value (other taste)
 cultivation n.s.
 variety n.s.
 interaction 0.0030

Johansson et al. 1999. Food Pref. Qualit. 10, 289-298
fresh tomato fruits

| | organic tomato | p-value | conventional tomato | p-value |
|---------------------------|---------------------------|----------------|--------------------------------|----------------|
| <i>apperance</i> | | | | |
| red colour | 6.1-7.9 | 0.0001 | 5.2-6.9 | 0.0001 |
| <i>consistency</i> | | | | |
| firmness | 4.4-7.0 | 0.0001 | 5.3-7.0 | 0.0001 |
| juicess | 4.8-6.9 | 0.0061 | 5.5-6.9 | 0.0012 |
| <i>taste</i> | | | | |
| acidulous | 4.3-6.0 | 0.0001 | 5.1-6.1 | 0.0133 |
| sweet | 4.3-6.1 | 0.0001 | 4.5-5.2 | 0.4344 |
| tomato taste intensity | 2.8-5.1 | 0.0001 | 4.4-4.9 | 0.8653 |
| bitter | 1.5-1.9 | 0.1350 | 1.5-1.7 | 0.7086 |

**r² coefficient for selected results of chemical and sensory attributes
tomato juices from organic and conventional production**

| | lycopene/colour | beta-carotene/colour | flavonols/bitter taste | phenolic acids/bitter taste |
|--------------|---------------------------|--------------------------------|-------------------------------|-----------------------------|
| organic | 0.05 | 0.34 | 0.87 | 0.18 |
| conventional | 0.11 | 0.79 | 0.56 | 0.29 |
| | flavonols/overall quality | phenolic acids/overall quality | dry matter/ feeling of pieces | |
| organic | 0.24 | 0.03 | 0.68 | |
| conventional | 0.48 | 0.81 | 0.01 | |

Conclusions:

- 1. Fresh organic tomatoes contained more dry matter, vitamin C, β -carotene, flavonols and phenolic acids than conventional ones.**
- 2. Conventional tomato fruits contained more lycopene than organic ones.**
- 3. Organic tomato juice contained more dry matter, vitamin C, lycopene, flavonols and phenolic acids than conventional products that were richer in β -carotene.**
- 4. Fresh organic tomatoes and tomato juices can be recommended in health preventive diet, because they contain a lot of the bioactive compounds.**

Thank you for attention

