



The content of bioactive compounds in the apples variety Gold Millenium® and in the apple polyphenolic preparations produced thereof



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Plan of presentation

- ▶ Introduction
- ▶ Aim of work
- ▶ Methods
- ▶ Results
- ▶ Conclusions

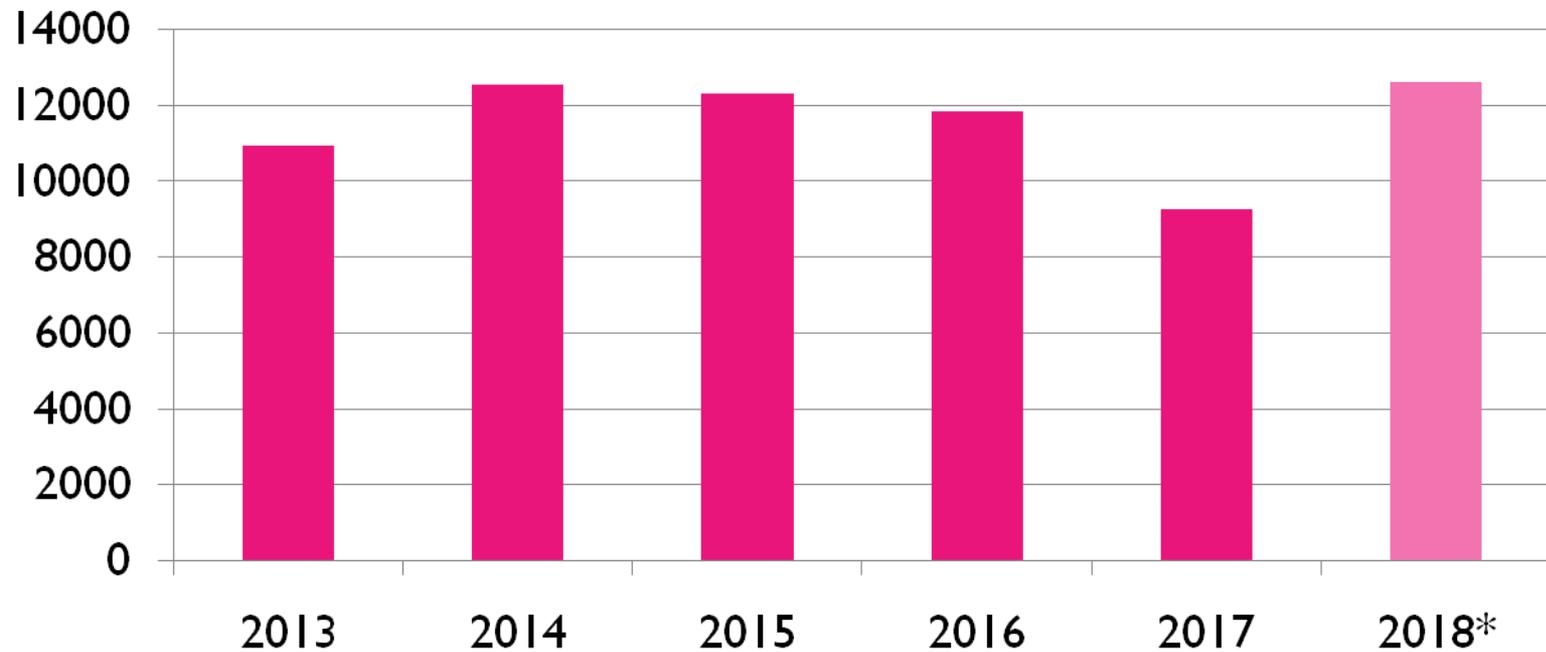


Why such topic?

- ▶ Production of apples in Europe and Poland is growing steadily.
- ▶ Apples contain a number of active substances having a positive impact on health.
- ▶ Organic apples should have a higher nutritional value than conventional apples (a hypothesis).
- ▶ Preserves of fruits may have more health promoting properties than the raw material.

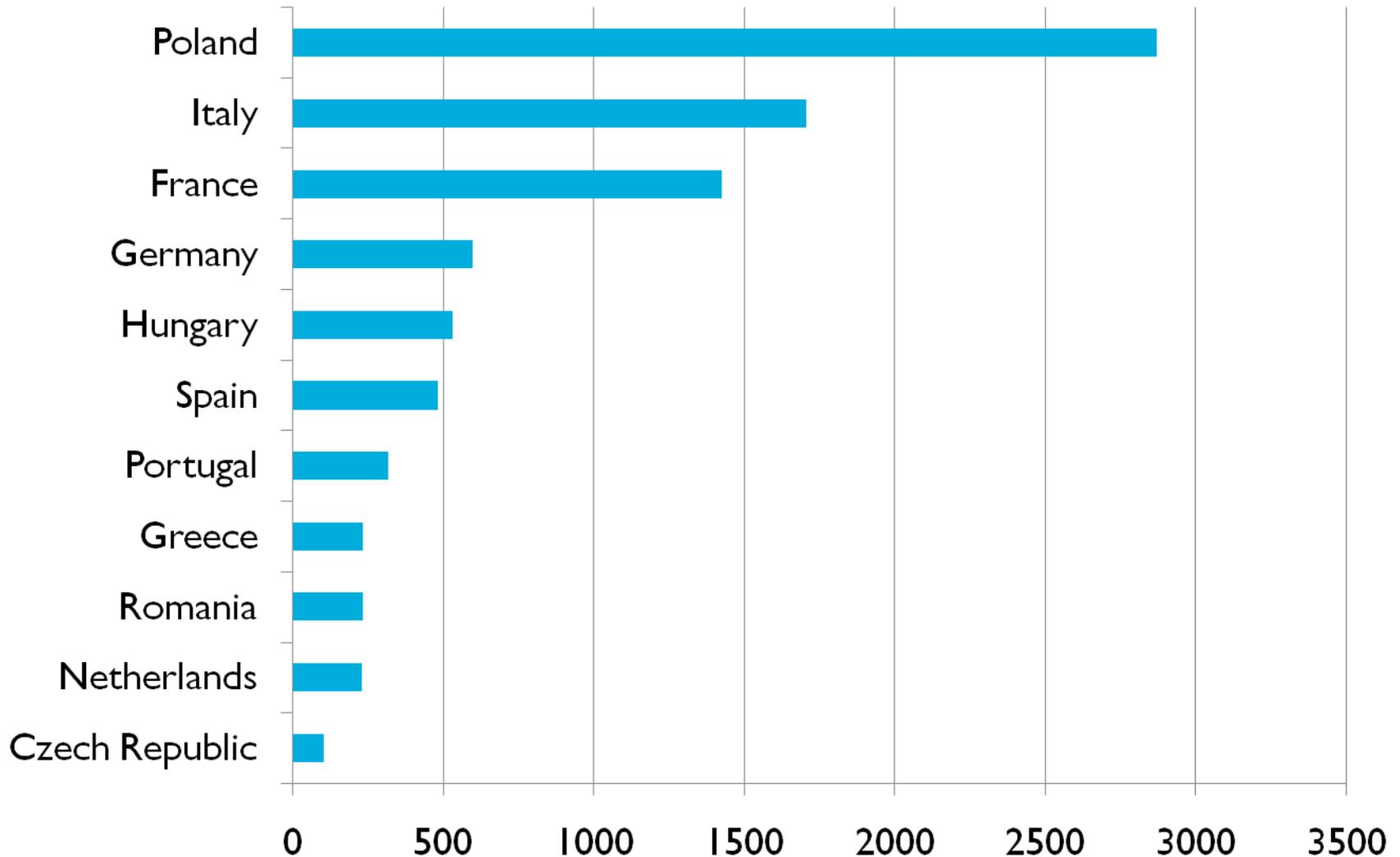


Production of apples in UE (1000 MT)

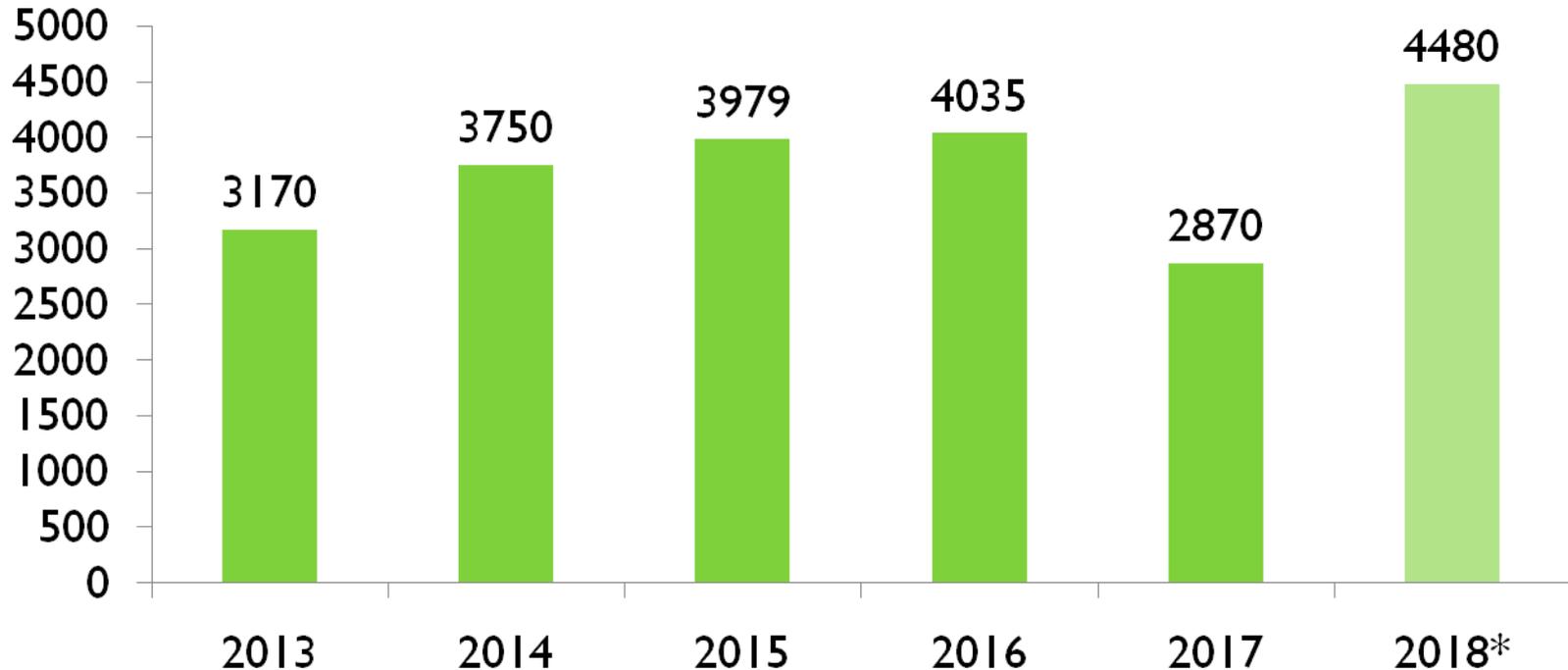


- ▶ The EU crop for apples in **2018** is forecast at **12.6 million MT**.
- ▶ The forecast number includes **151,000 MT of organic apples**.

The biggest apple producers in UE in 2017 (1000 MT)

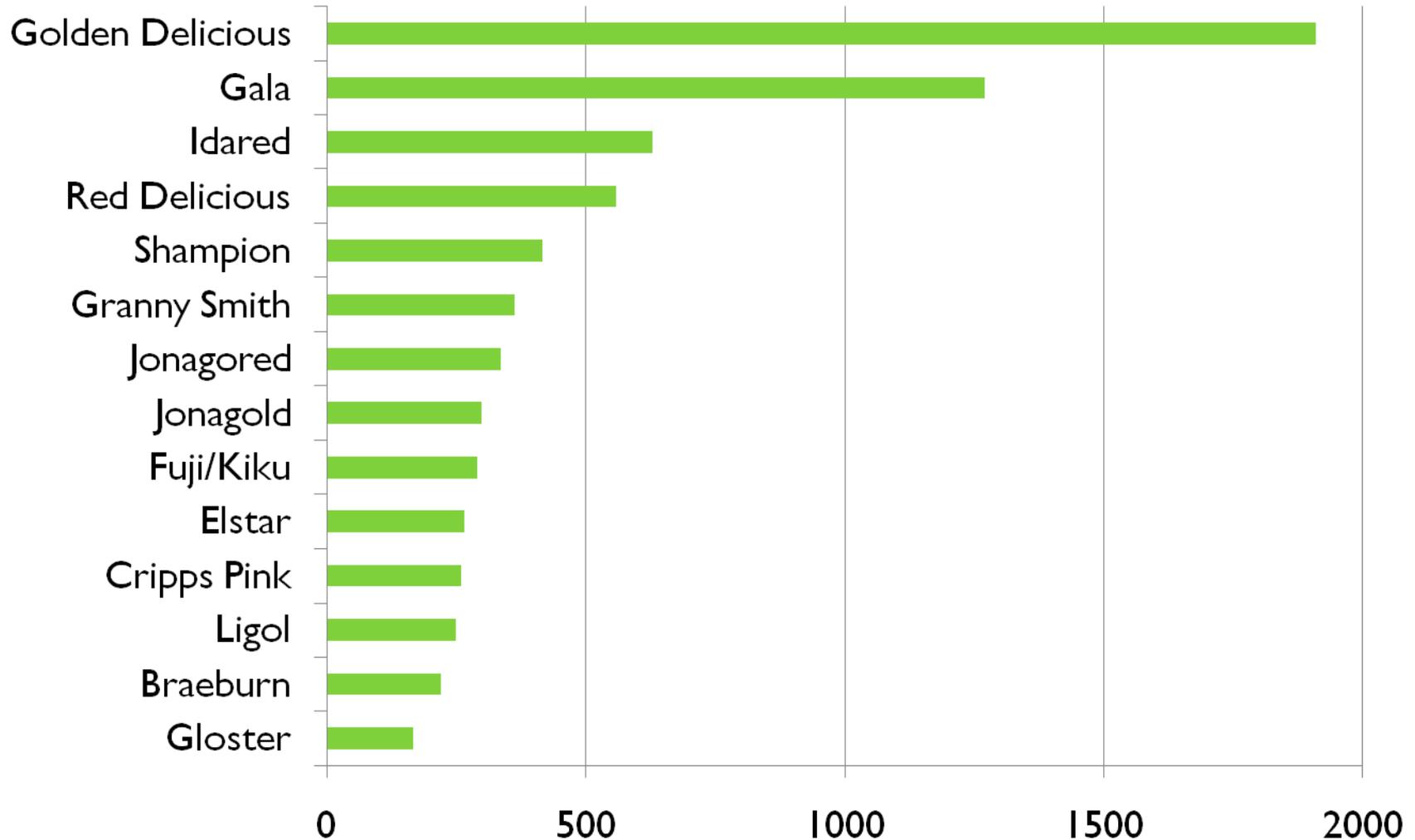


Apple production in Poland (1000 MT)



- ▶ Polish production outpaces consumption as new orchards come into production. This could pose a problem in the coming years if Poland does not find new markets.

EU apple production- the most common varieties, in 2017 (1000 MT)



Nutritive quality of apples

Energy value	[kcal/k]]	50/ 209
Proteins	[g]	0,4
Fat	[g]	0,4
Total carbohydrates	[g]	12,1
Dietary fibre	[g]	2
Ash	[g]	0,3
Vitamin C	[mg]	9,2
B-carotene	[µg]	24
Vitamin A	[µg]	4
Folates	[µg]	6

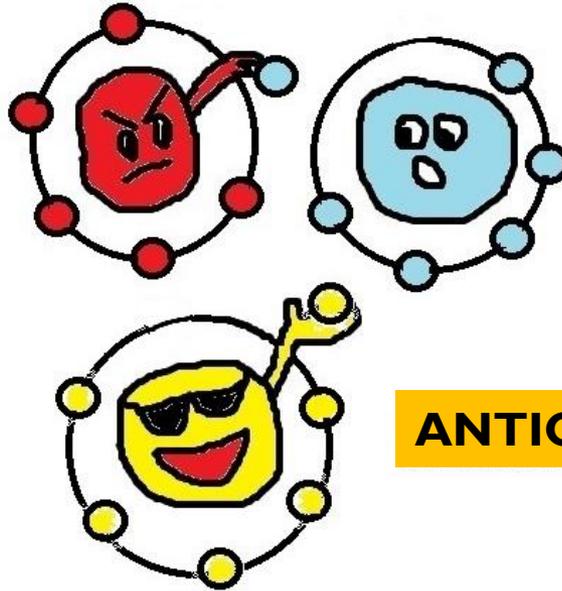
**Apples are the main source of flavonoids
in our diet – ca. 400 mg in one apple!**

Bio compounds

- ▶ Polyphenols, especially flavonoids and anthocyanins;
- ▶ Carotenoids;
- ▶ Vitamin C.

All of them exhibit strong antioxidant properties:

**FREE
RADICAL**



HEALTHY CELL

ANTIOXIDANT



Impact on antioxidants on health

Many lifestyle diseases of the 20th century, like obesity, type II diabetes, allergies, cardiovascular and autoimmune diseases are the effects of free radicals.

Antioxidants inhibit destructive action of free radicals, which affect cells → tissues → organs, and consequently the whole organism.



Polyphenolic antioxidants in apples

- ▶ Chlorogenic acid, the main phenolic acid present in the apple, has a great ability to “scavenge” free radicals.
- ▶ Compared to about 18 other antioxidant compounds, chlorogenic acid was the second, immediately after the rutin, among antioxidants possessing the highest activity.
- ▶ Polyphenolic antioxidants of apple are mainly responsible for the antioxidant activity of these fruits.
- ▶ The contribution of vitamin C to the total antioxidant potential of apple is less than 0.4%, so small...

Phenolic compounds in apples

- ▶ The apples more abundant in phenolic compounds tended to have a higher antioxidant activity.
- ▶ Antioxidant properties of apples highly dependent on the fruit variety, agricultural practices, weather, storage conditions and processing.



Conventional or organic production?

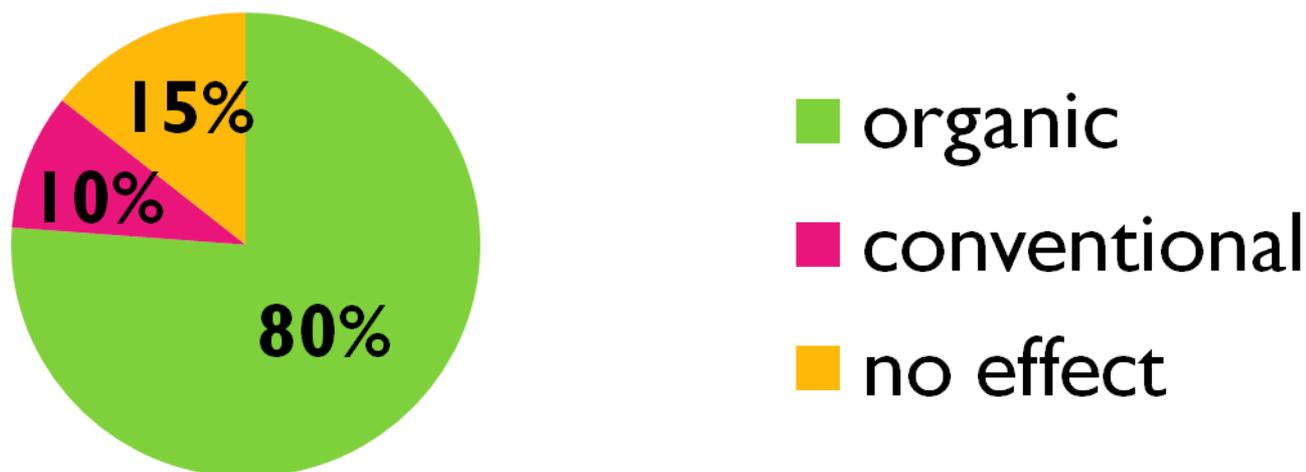
The postharvest quality of organically and conventionally produced fruits are significantly different.

- ▶ Most of the differences detected between the two production systems could be strongly linked to differences in pest and soil management strategies, especially nitrogen fertilizers.
- ▶ According to the literature reviewed, organically produced fruits have **higher content of:**
 - ▶ **Antioxidants, in that:**
 - ▶ **Hydroxycinnamic acids, flavanols, dihydrochalcones, quercetins and total phenolic compounds**
 - ▶ **Vitamins.**



Effect of organic and conventional production system on phenolic contents of fruits

Meta-analyse based on 17 papers showed that most papers testify to higher phenolic content in organic fruits:



- ▶ Application of pesticides, particularly synthetic herbicides, may reduce carbon fixation by plants and consequently decrease the carbon available for the synthesis of phenolics.

Effect of organic and conventional production system on pesticides contents of fruits at postharvest

The detectable pesticide residues in organically grown foods are 30% lower compared to conventionally grown foods.

- ▶ Higher levels of pesticides in the urine of consumers of conventionally grown food compared with consumers of organic food have been reported.
- ▶ Organic food consumers had six-time lower levels of organophosphate pesticide residues than those who consumed conventionally grown food.



Aim of work

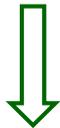
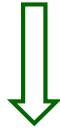
The aim of study was to examine the effect of two cultivation systems (organic vs. conventional) on the content of bioactive compounds in the apples variety Gold Millenium® and in the apple polyphenolic preparations produced thereof.



Design of the experiment

Apples of the variety Gold Millennium®
SajSad (orchard organically certified)

Apples of the variety Gold Millennium®
SajSad (orchard conventionally certified)



Chemical analysis of organic
apples & preparations

Chemical analysis of
conventional apples &
preparations

► JP 1,2,3,4,5,6 - different apple preparations

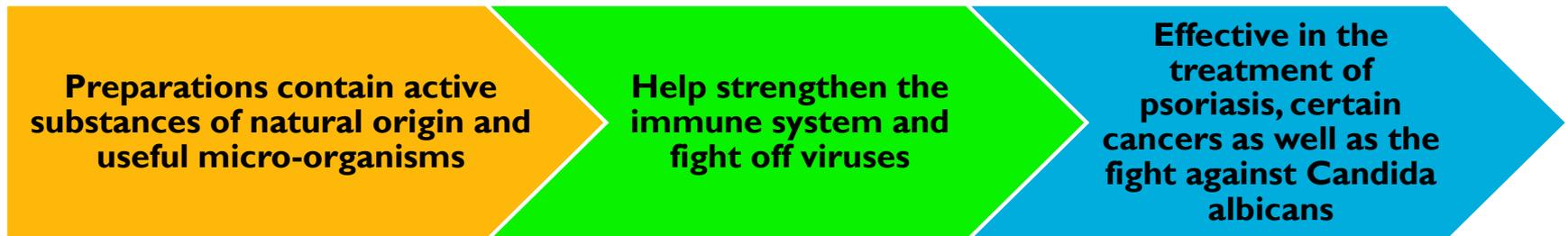
Polyphenolic preparations

- ▶ Apples Gold Millenium® are characterized by high palatability and their high resistance to disease due to the organic cultivation. This variety contains a lot of antioxidants and about 4 times more pectins than other varieties.
- ▶ Innovative products - preparations pectinGOLD made of Polish apples variety Gold Millenium® grown in the organic farm "Sajsad" in the Podlaskie Voivodeship.



PectinGold preparations

- ▶ These preparations are metabolites of dried apple pulp variety Gold Millennium ® exposed to a special treatment tending to increase biological activity. The treatment and composition of bacteria are a trade secret – a procedure is patented and marketed under the trade name PectinGOLD.



- ▶ **Technological process of preparations' production with the help of bacteria contributes to significant increase of the polyphenolic compounds concentration.**
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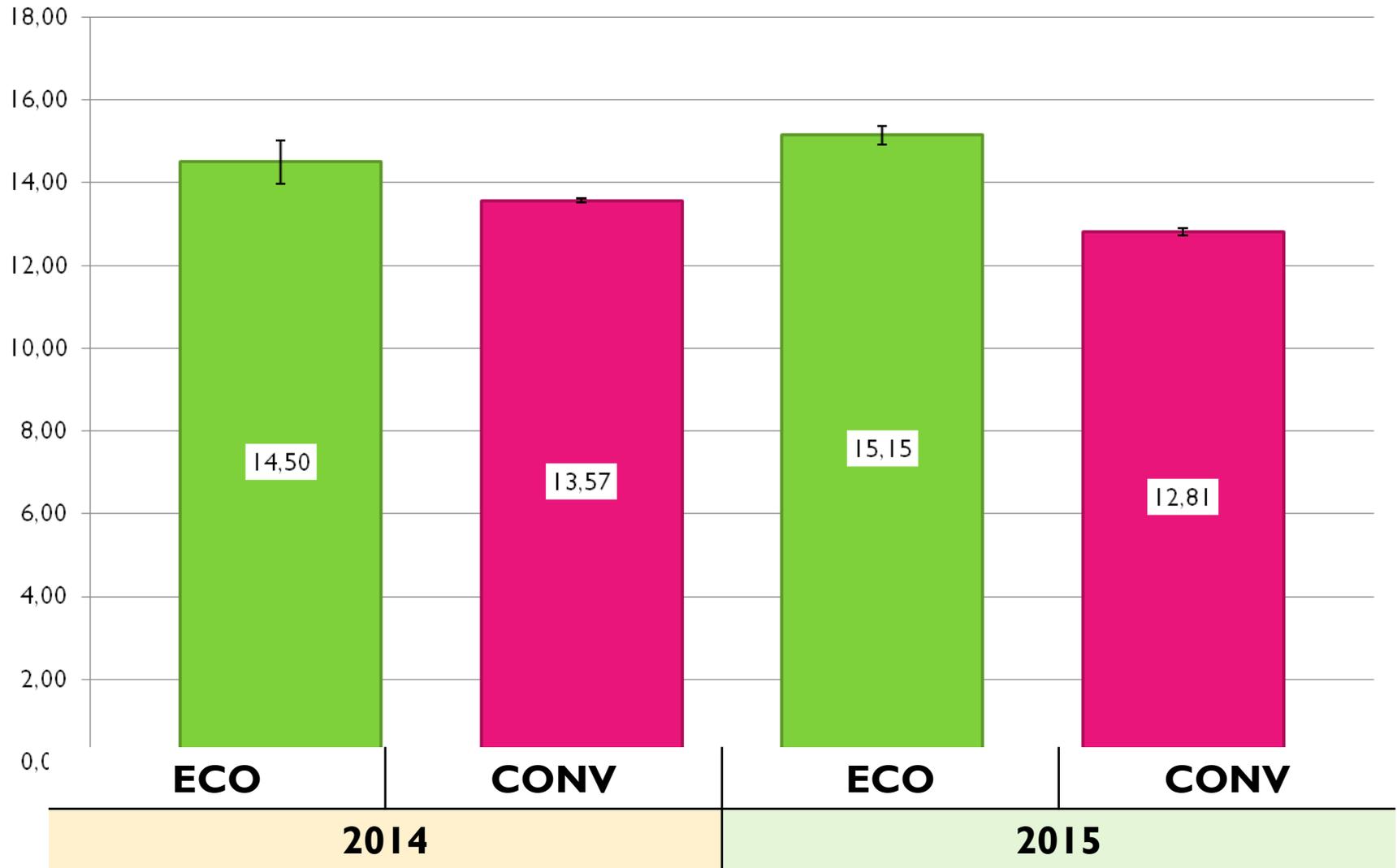


Analytical methods:

- ▶ Dry matter content by scale method (Polish Norm PN-R-04013 : 1988)
- ▶ Total and reducing sugars content by Luff-Schoorl's method (Fortuna et al. 2003)
- ▶ Total acidity by titration method (Polish Norm PN-A-75101-04 : 1990)
- ▶ Polyphenols content (quantity and quality) by HPLC method (Hallmann et al. 2017)
- ▶ Carotenoids and chlorophylls content (quantity and quality) by HPLC method (Hallmann et al. 2017)
- ▶ Vitamin C by Tillmans method (Polish Norm PN-A-75101-11 : 1990)



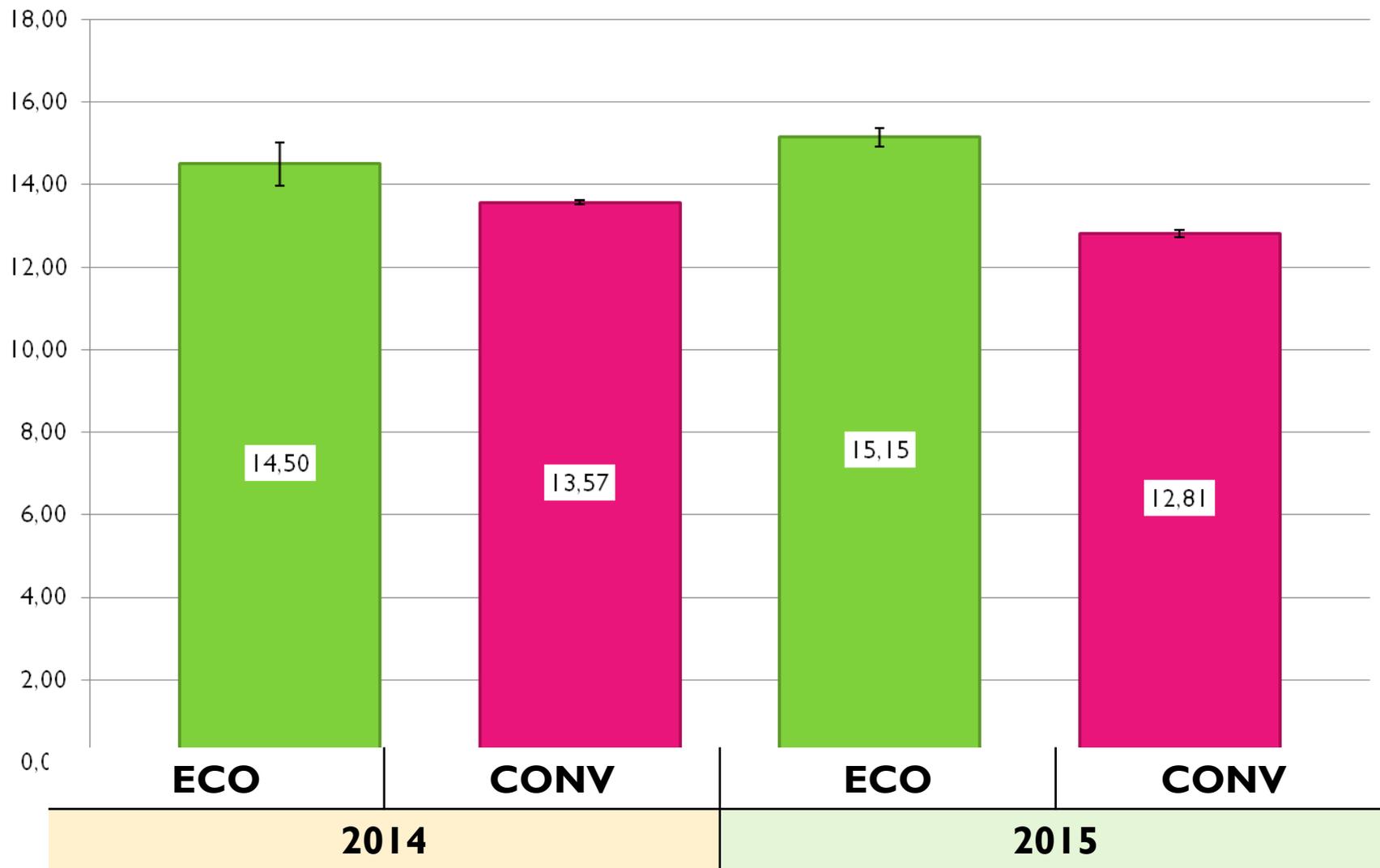
The average content of **dry matter** in Gold Millenium®
apples from organic and conventional cultivation
(g/100g FM), p-value year of production(ECO+CONV)=0,9200



▶ **p- value:** method of cultivation₂₀₁₄ = 0,0260; method of cultivation₂₀₁₅ = 0,0644

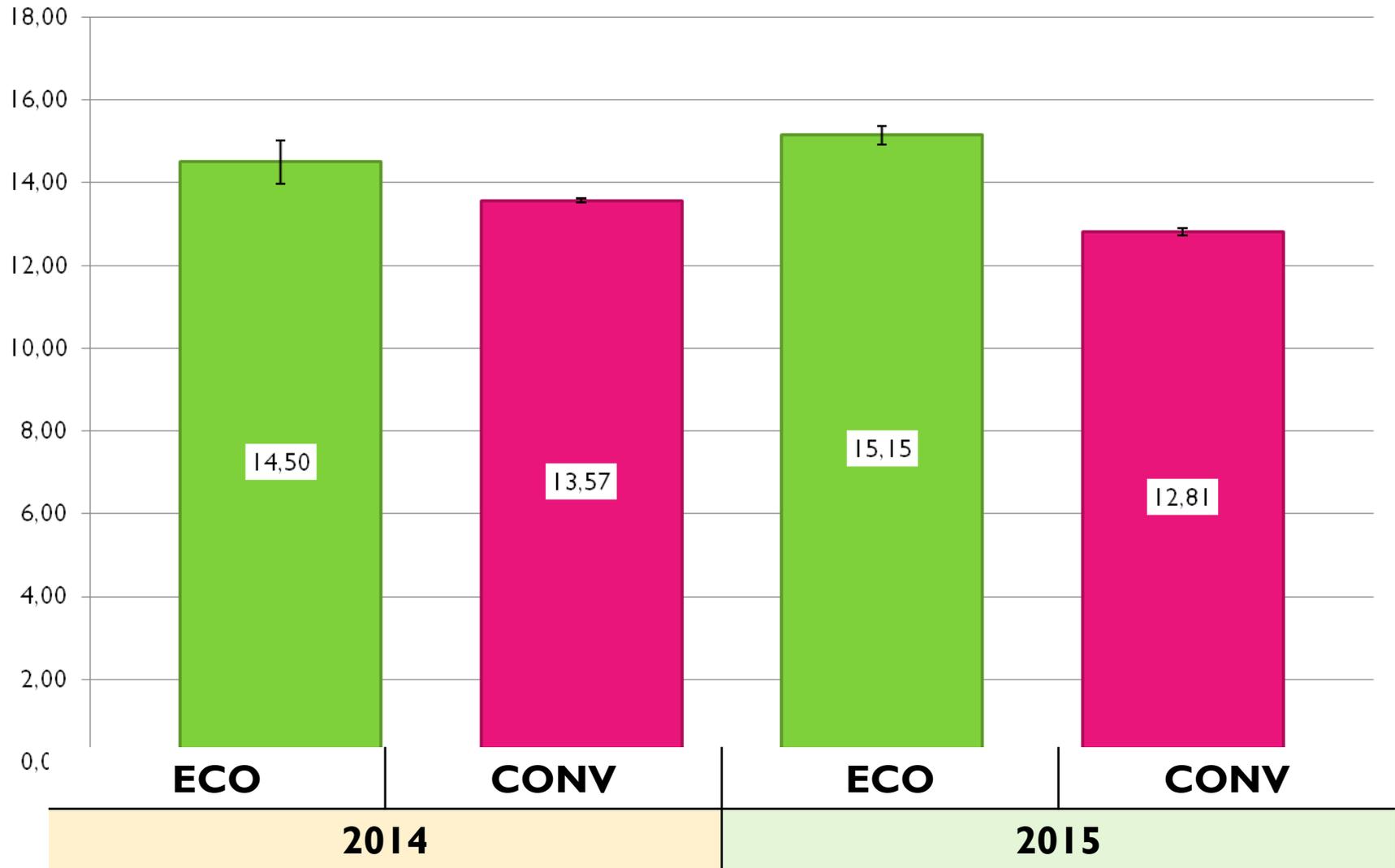
The average content of **reducing sugars** in Gold Millenium® apples from organic and conventional cultivation

(g/100g FM), p-value year of production(ECO+CONV)=0,0025



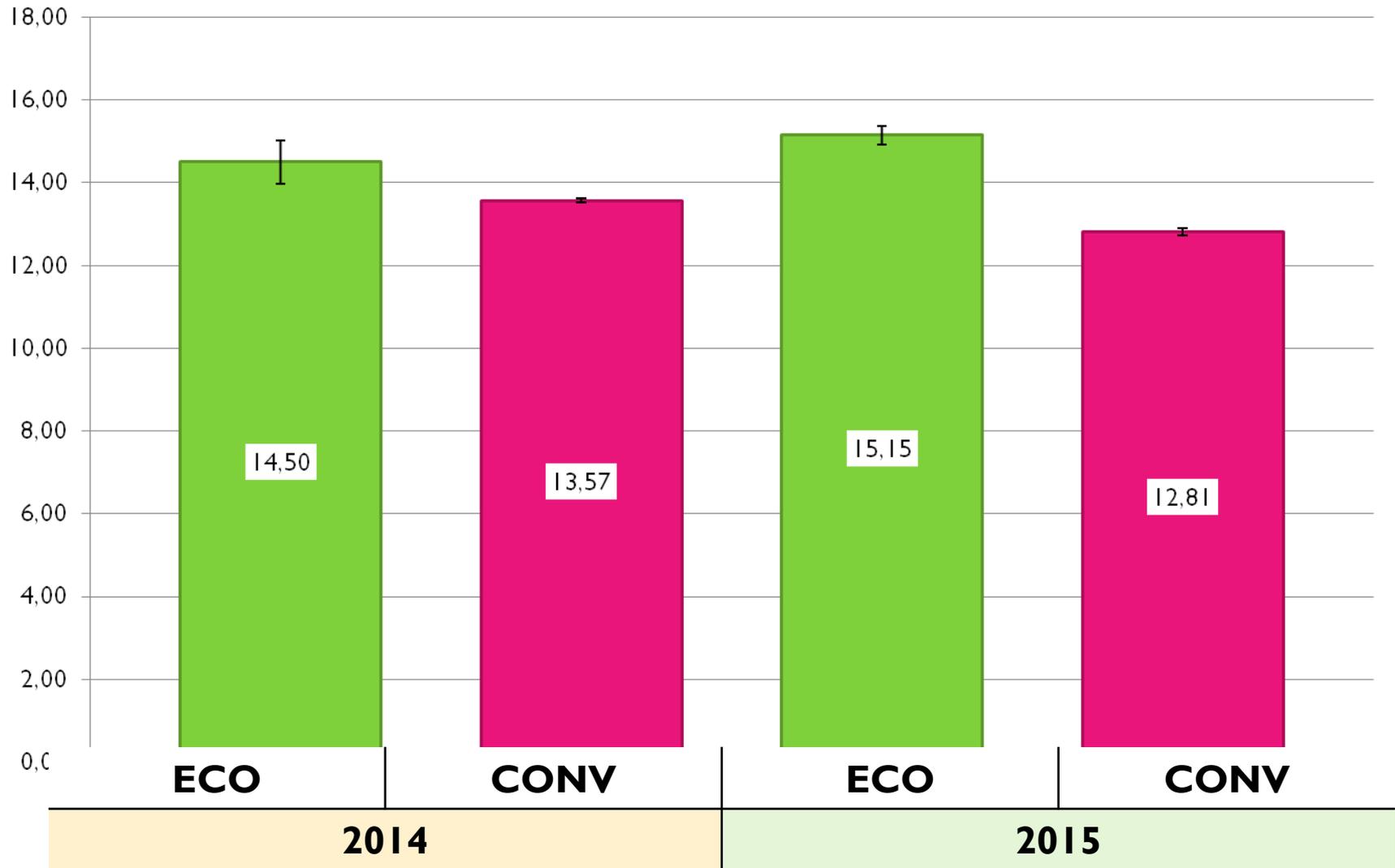
▶ **p- value:** method of cultivation₂₀₁₄ = 0,0037 ; method of cultivation₂₀₁₅ <0,0001

The average content of **total sugars** in Gold Millenium® apples from organic and conventional cultivation (g/100g FM), p-value year of production(ECO+CONV)=0,1607



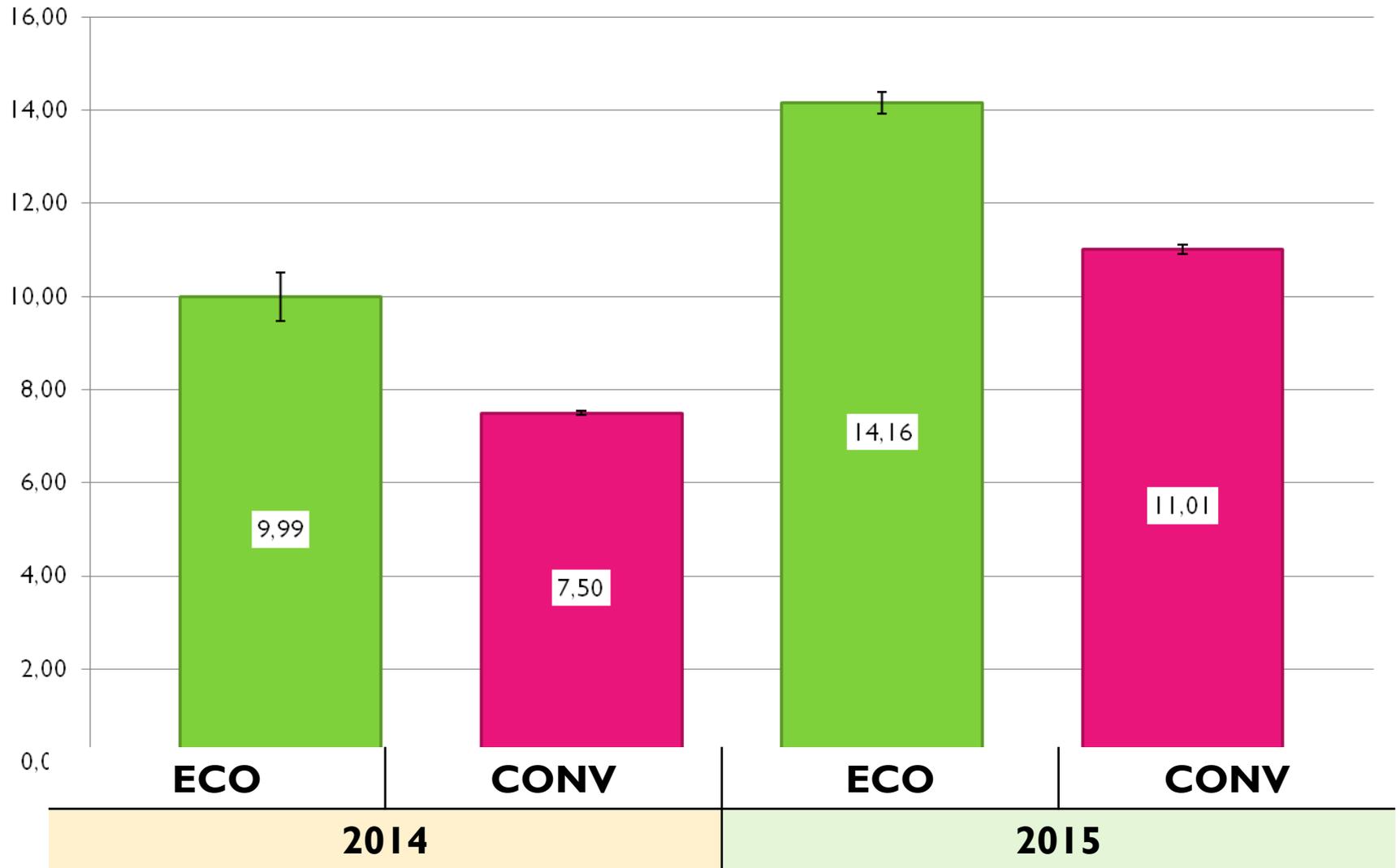
▶ **p- value:** method of cultivation₂₀₁₄ = 0,1587 ; method of cultivation₂₀₁₅ = 0,0090

The average content of **total acidity** in Gold Millenium® apples from organic and conventional cultivation (mg/ 100g FM), p-value year of production(ECO+CONV)=0,0001



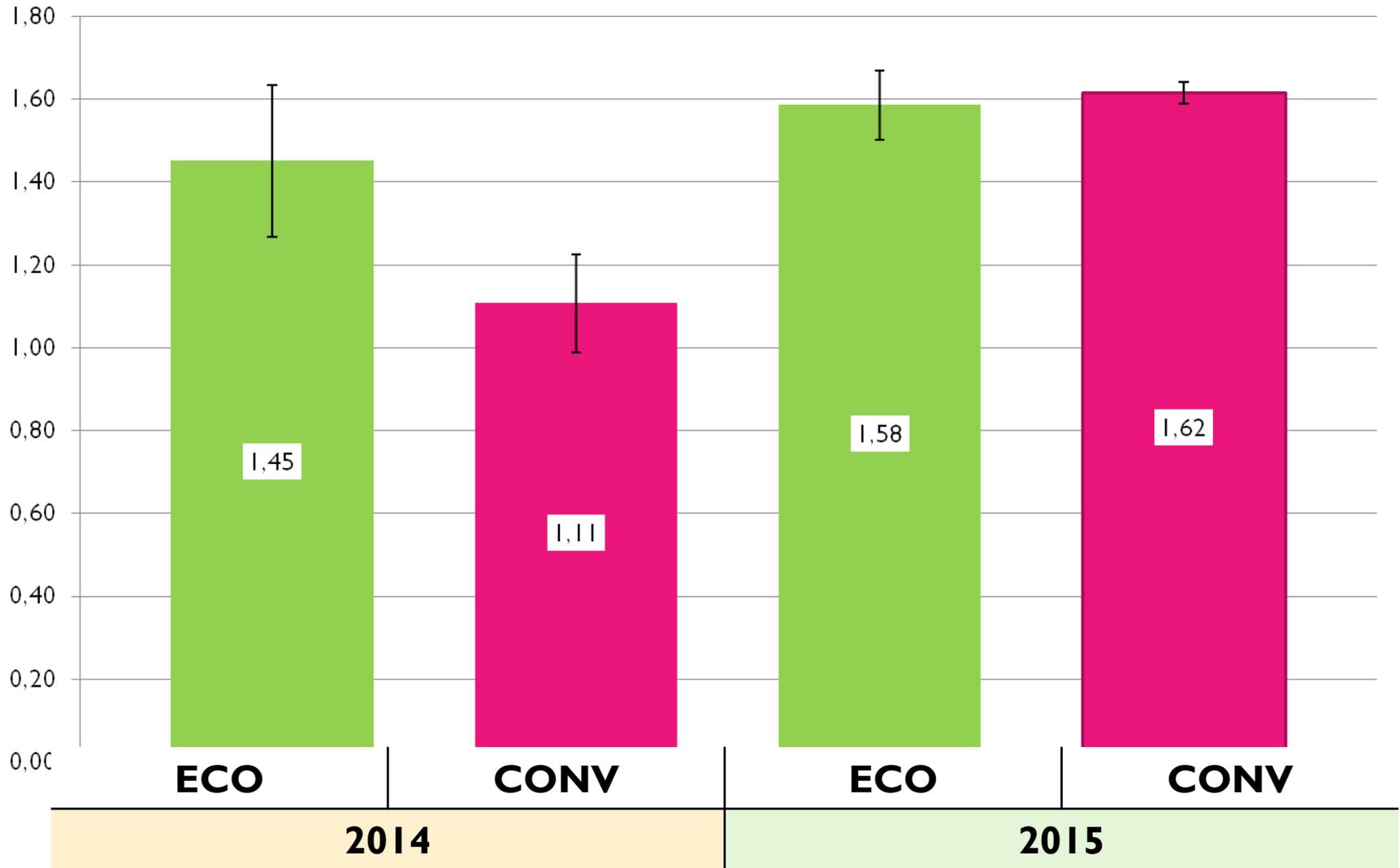
▶ **p- value:** method of cultivation₂₀₁₄ = 0,0004 ; method of cultivation₂₀₁₅ = 0,0081

The average content of **vitamin C** in Gold Millenium® apples from organic and conventional cultivation (mg/100g FM), p-value year of production (ECO+CONV)<0,0001



▶ **p- value:** method of cultivation₂₀₁₄ <0,0001 ; method of cultivation₂₀₁₅ =0,0017

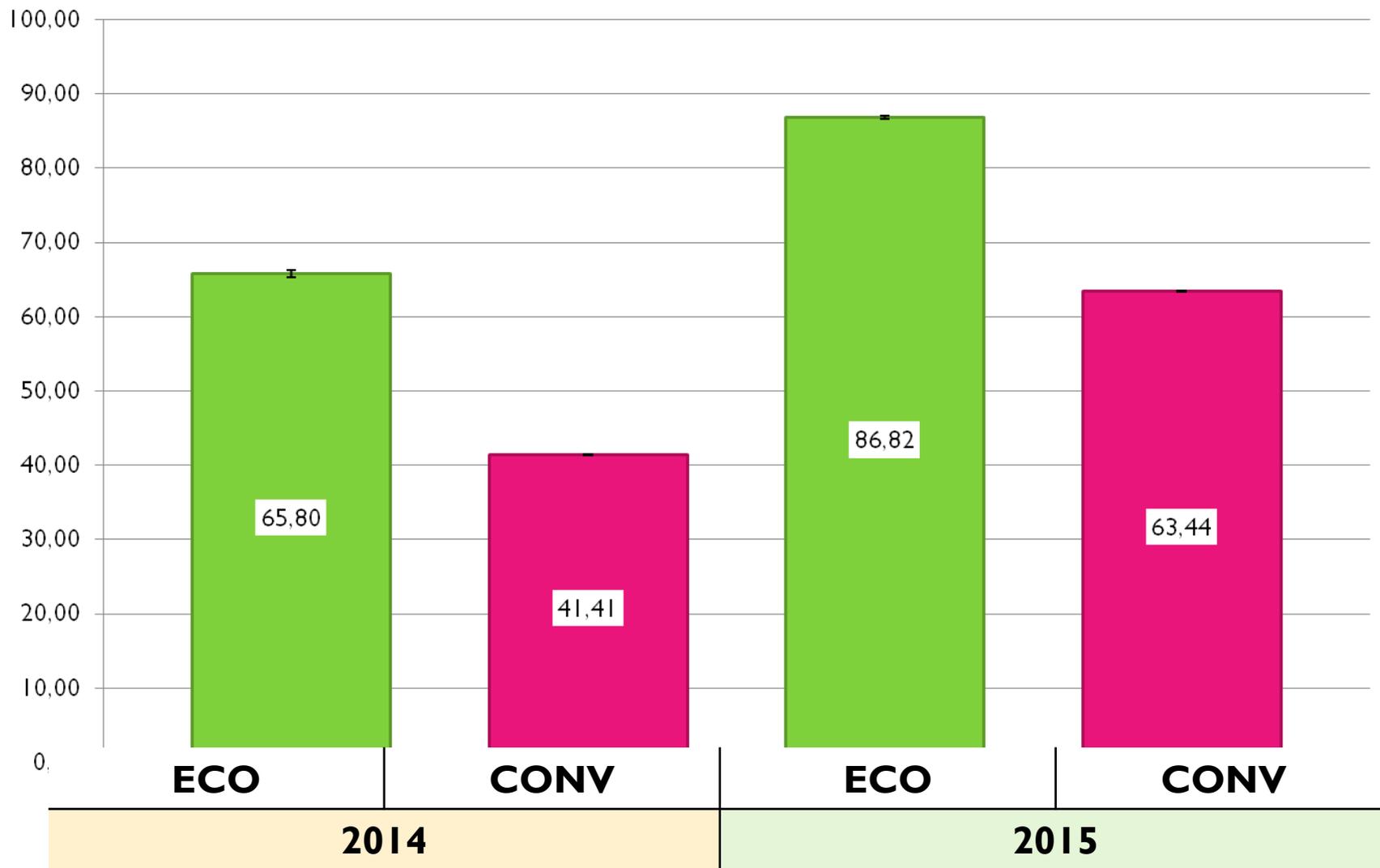
The average content of **total carotenoids** in Gold Millenium® apples from organic and conventional cultivation (mg/ 100g FM), p-value year of production (ECO+CONV)<0,0001



▶ p- value: method of cultivation₂₀₁₄ =0,0002 ; method of cultivation₂₀₁₅ =0,3197

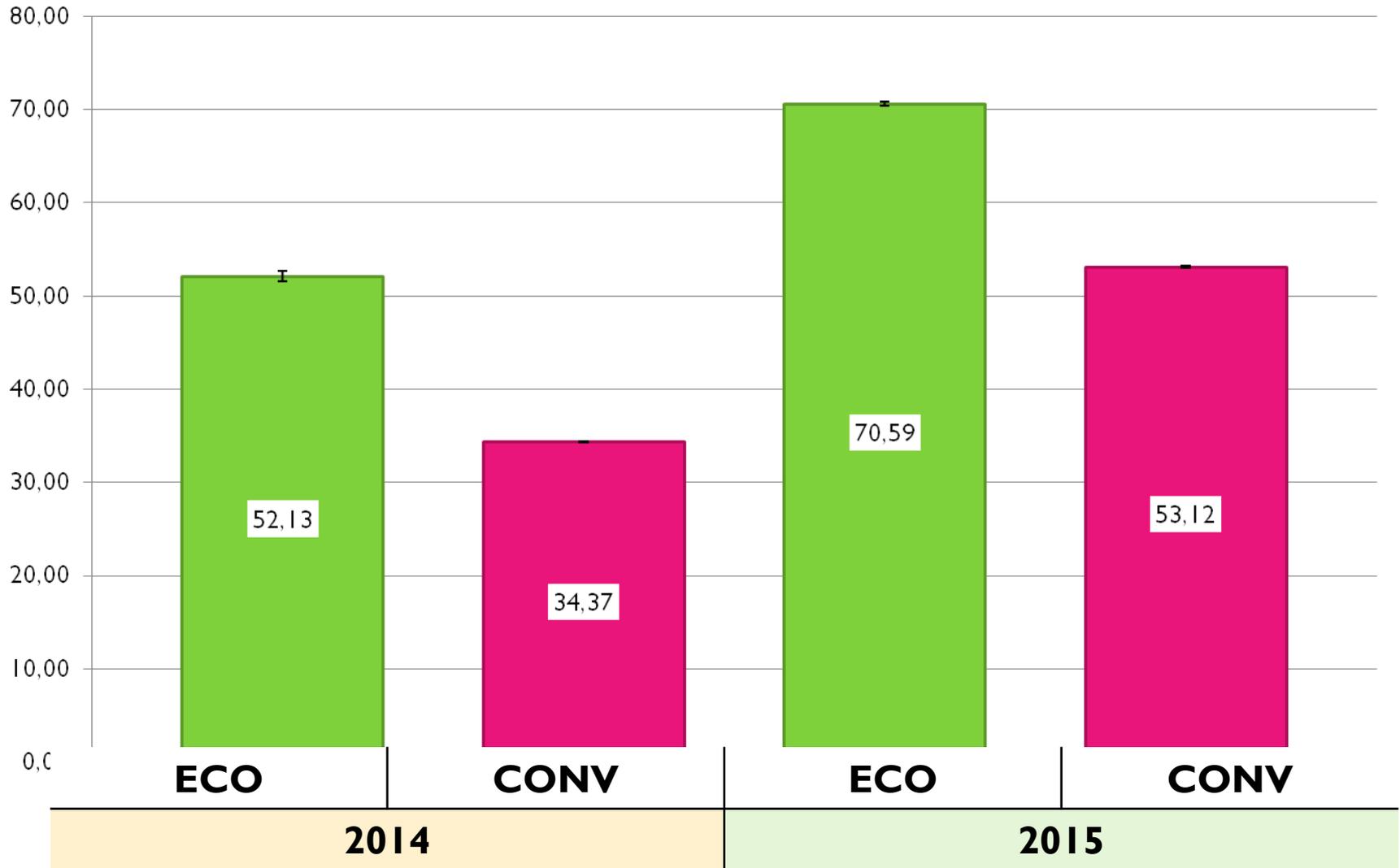
The average content of **total polyphenols** in Gold Millenium® apples from organic and conventional cultivation

(mg/100g FM), p-value year of production (ECO+CONV) < 0,0001



▶ p-value: method of cultivation₂₀₁₄ < 0,0001 ; method of cultivation₂₀₁₅ < 0,0001

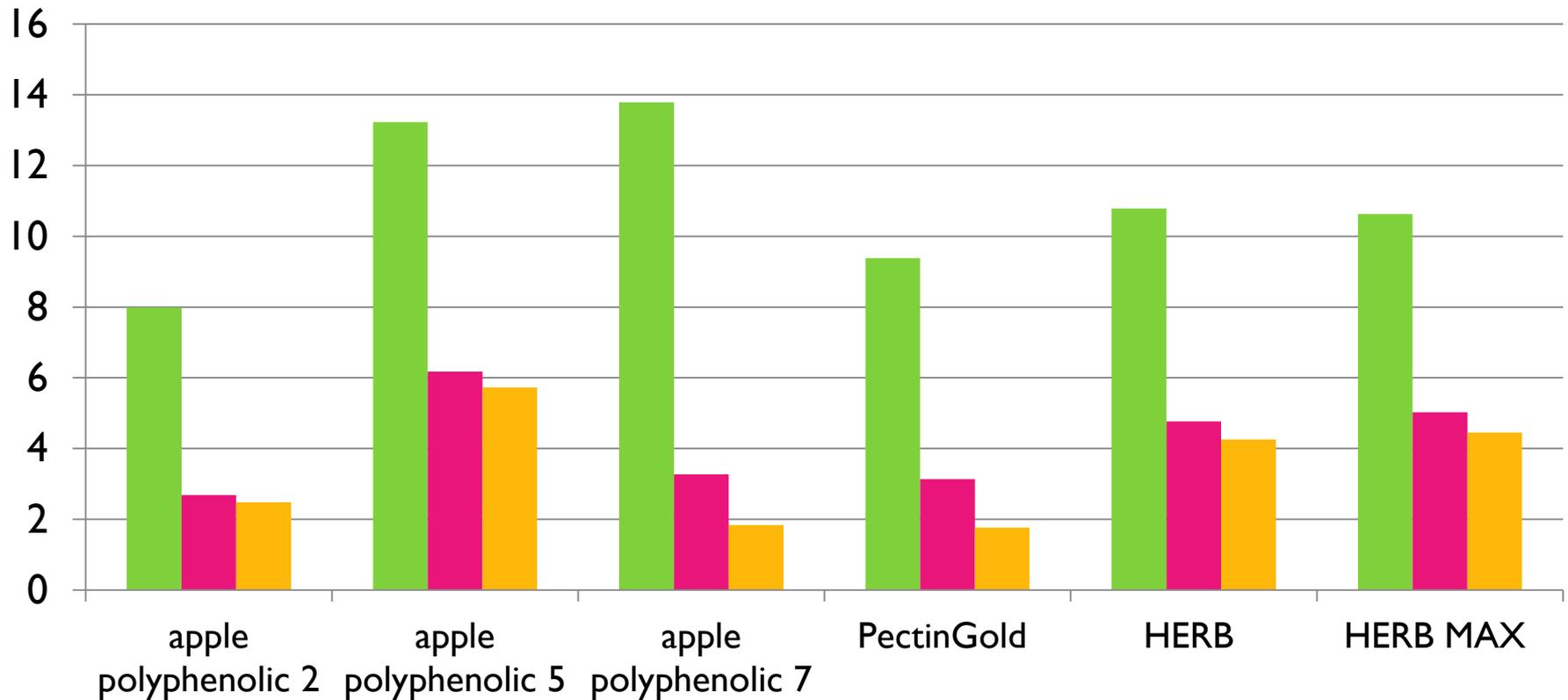
**The content of total flavonoids in Gold Millenium® apples
from organic and conventional cultivation**
(mg/100g FM), p-value year of production (ECO+CONV)<0,0001



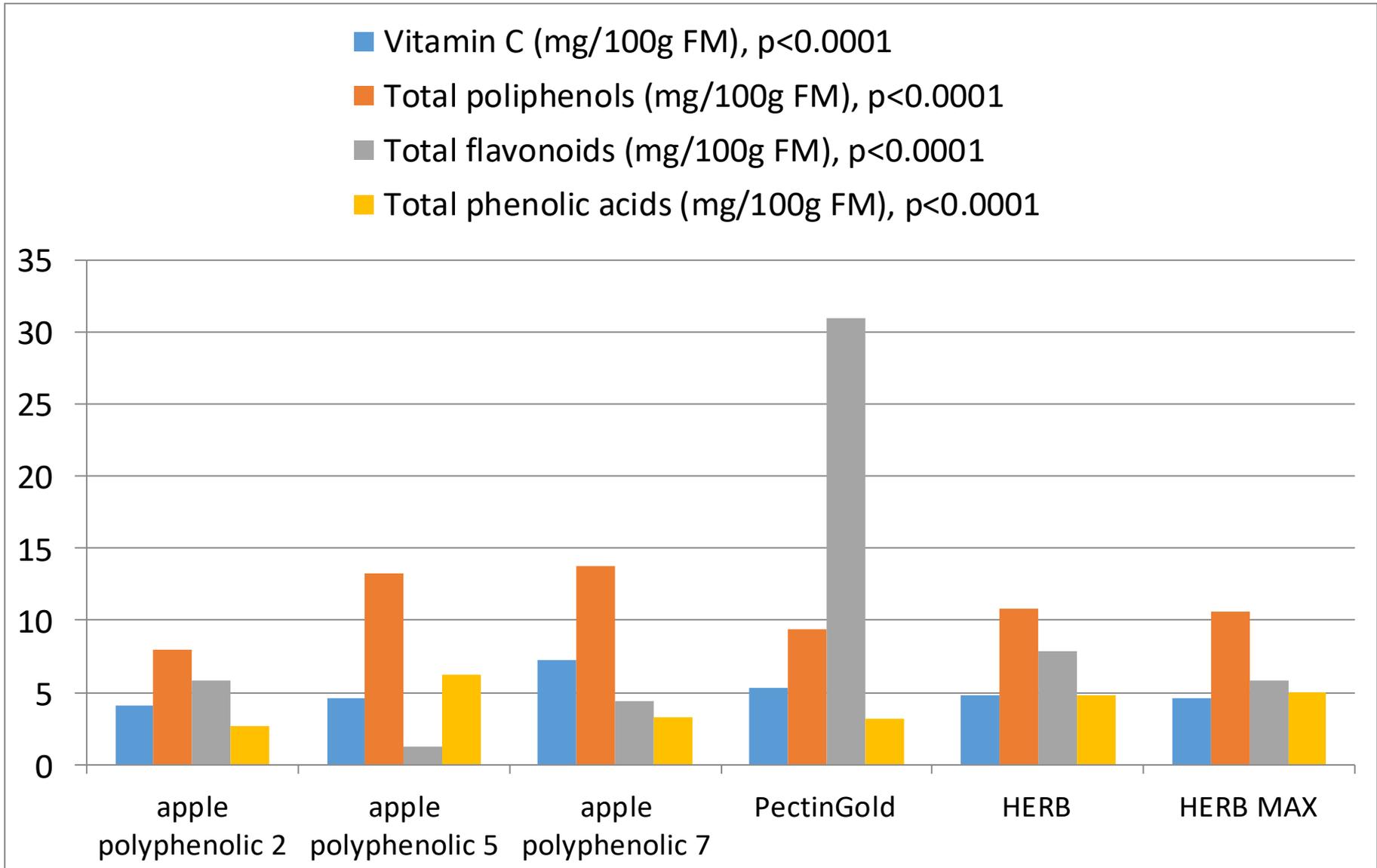
▶ **p- value:** method of cultivation₂₀₁₄ <0,0001 ; method of cultivation₂₀₁₅ <0,0001

The average content of **dry matter**, **total sugars** and **reducing sugars** in polyphenolic preparations produced from Gold Millenium® apples

- dry matter (g/100g FM), $p < 0,0001$
- total sugars (g/100g FM), $p = 0,0338$
- reducing sugars (g/100g FM), $p = 0,0018$



The average content of vitamin C, total polyphenols, total flavonoids and total phenolic acids in polyphenolic preparations produced from Gold Millenium® apples



Summary

- ▶ 1. The level of reducing sugars, organic acids, vitamin C, total polyphenols and total flavonoids was significantly higher in the organically produced apples compared to the conventional ones in both study years.
- ▶ 2. The year of production had also significant impact on the level of some biocompounds – reducing sugars, organic acids, vitamin C, total carotenoids, total polyphenols and total flavonoids; in most cases the level was higher in 2015 than in 2014.
- ▶ 3. The level of bio compounds in the apple preparations was different depending on a type of the preparation. Level of dry matter and total sugars was the highest in preparation 5, and level of polyphenols was the highest in Pectin Gold preparation.



Conclusions

- ▶ The cultivation method had a clear impact on the composition of apples Gold Millenium® - organic system enhanced the level of bio compounds in fresh apples
- ▶ These result are in line with many other studies showing the higher content of bio-compounds in the organically vs. conventionally produced crops (e.g. meta-analysis Barański et al. 2014).
- ▶ The level of polyphenols in the preparations was much higher than in the fresh apples. It can be explained by the biochemical changes and densification going on during the treatment of apples.
- ▶ It can be concluded that organic apples and preparations produced thereof are very good source of polyphenols, so they can be recommended in a healthy diet.



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Thanks for your attention!

