Polish white mulberry (*Morus alba* L.) and new directions of its utilization

Małgorzata Łochyńska

Institute of Natural Fibres and Medicinal Plants
Department of Silkworms Breeding and Mulberry Cultivation
Wojska Polskiego 71b
60-630 Poznan, Poland
e-mail: malgorzata.lochynska@iwnirz.pl

White mulberry

- infusion and tea of leaves as diaphoretic and emalliorent, applied for gargling in inflammations of throat,
- the fruits as a laxative,
- the roots - anthelmintic activity and astringent properties and the bark is used as a purgative and vermifuge,
- white mulberry mainly known for its excellent antidiabetic action.

White mulberry

- 15-31% high quality protein,
- crude fiber,
- 200-300 mg/100g of ascorbic acid, of which over 90% is present in the reduced form,
- vitamin B, D, folic acid, folinic acid, β-carotenes,
- essential macroelements (K, Ca, Mg, Na, P) and microelements (Fe, Zn, Ni),
- flavonoids (quercetin, rutin, isoquercitrin, astragalin, kuwanon G and C, catechin, mulberrofuran G, albanol B, morusin, sanggenon B and D),
- anothocyanins.

White mulberry

- decoction of leaves as diaphoretic mean, for gargling in inflammations of throat,
- fruits as a laxative mean,
- roots as anthelmintic and astringent mean,
- extract of leaves as antidiabetic mean (flavonoids lower blood glucose level by inhibiting enzyme activity),
- strong antioxidant activity,
- strong antifungial and antibacterial potential (*Bacillus*, *Staphylococcus*, *Escherichia*, *Streptococcus*),
- against viruses activity (*Herpes simplex* type 1),
- cytotoxic activity against rat liver cancer cells, human leukemia and melanoma cell in mice,
- in allergies to stimulate lymphocyte proliferation and reduce the production of antibodies,
- cyanidin from fruits protect the brain against endothelial dysfunction and reduce the likelihood of Alzheimers's disease,
- prevent and inhibit atherosclerosis – strong inhibitory effect on LDL oxidation and lower blood preasure,
- local whitening of skin (depigmentation of lentigo, ephelide, melanoma).

White mulberry

- a fodder for mulberry silkworms (*Bombyx mori* L.),
- in India annual shoots, available after silkworm breeding season, are cut, dried and used as the main renewable source of fuel,
- a natural dyeing plant,
- in the paper, furniture and sport equipment industry,
- a substrate for oyster mushrooms *Pleurotus* sp.,
- leaves (not only fruits) are eaten by vegetarians,
- leaves and fruits as fodder for birds, reptiles and rodents,
- binding materials,
- for making baskets and wheels for wood waggons,
- in gardening.

Polish white mulberry

- cultivar Zolwinska
- bred in 1950’s in Milanowek, near Warsaw, Poland
- plantation in Experimental Farm in Petkowo INF&MP
- huge leaves and rapid growth – designed for silkworm breeding
- black-coloured fruits were used in producing jam and wine
- forgotten plant

Zolwinska studies

- a proecological plantation in Experimental Farm INF&MP in Petkowo (52,12N; 17,15E)
- studied material: shoots, leaves and fruits of Zolwinska cultivar and leaves and shoots of China and Kokuso cultivars (experimental plantation in Petkowo).
- there were measured:
  - morphological features,
  - energy value of shoots,
  - cellulose and pectin contents in shoots
  - and fatty acids content in seeds.

Zolwinska studies

The morphological features were carried out in July 2010. There were measured: length and width of the leaf, petiole length, distance from the leaves on the shoot, leaf color, fruit length and the stalk of a fruit. One hundred samples for each examination were taken.

Present measurements of Zolwinska cultivar were compared with two the most similar cultivars: Kokuso and China (with exception of fruits studies). All mulberries are cultivated in the same plantation conditions.

Zolwinska studies

The energy value was examined at the Department of Environment Protection INF&MP.
The dried annual shoots collected in July 2009 were used in the investigation. The research was carried out in the oxygen bomb calorimeter type KL-5.

Zolwinska studies

The content of cellulose and pectin was examined in the Harvesting Technology and Fibrous Raw Material Evaluation Department INF&MP.
The material – annual and two years old shoots – was collected in June 2010, cut into 3-4 cm peaces and died. Samples were melt in the mill and then wax and grease substances were removed. After chemical treatment the cellulose and pectin content was calculated.

Zolwinska studies

The fatty acids content was studied in the Department of Linseed and Hemp Seed Research and Processing INF&MP.
Seeds were collected from fresh black fruits, dried and melt. Extract of seeds after chemical treatment was examined in the gas chromatograph with flame detector (FID). Computer software TurboChrom makes all calculations of the fatty acids profile.

Results

The leaves of Zolwinska cultivar are the biggest, the petioles are the longest, shiny leaves are dark green coloured, with deeply serrated margins, the average length of black fruits is 1,59 cm and they are set on stalk (average length 0,8 cm). Such a huge leaves possess higher content of precious active substances (eg. flavonoids, vitamins and minerals) what is valuable for medicine and pharmaceutical industry.

Results

Feature	China cultivar	Kokuso cultivar	Zolwinska cultivar
length of leaf	10,55	10,45	19,45
width of leaf	7,7	8,25	12,34
length of petiole	2,38	2,06	4,49
distance between petioles	6	4,64	5,8
color of leaf	light green, mat	light green, mat	dark green, shiny

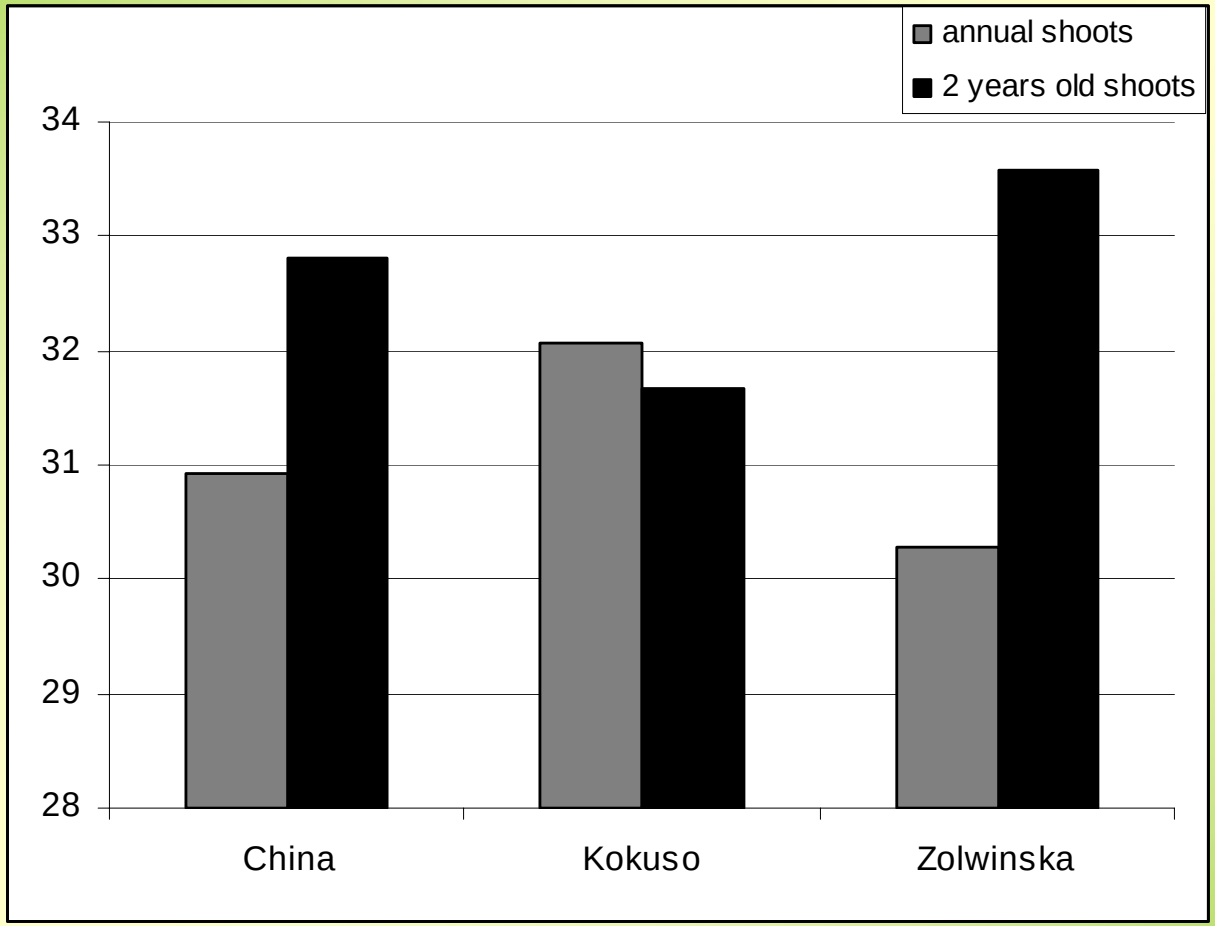
The comparison of morphological features of studied cultivars of white mulberry (all measurements in cm).

Results

The highest cellulose content was calculated for two years old shoots of Zolwinska cultivar.

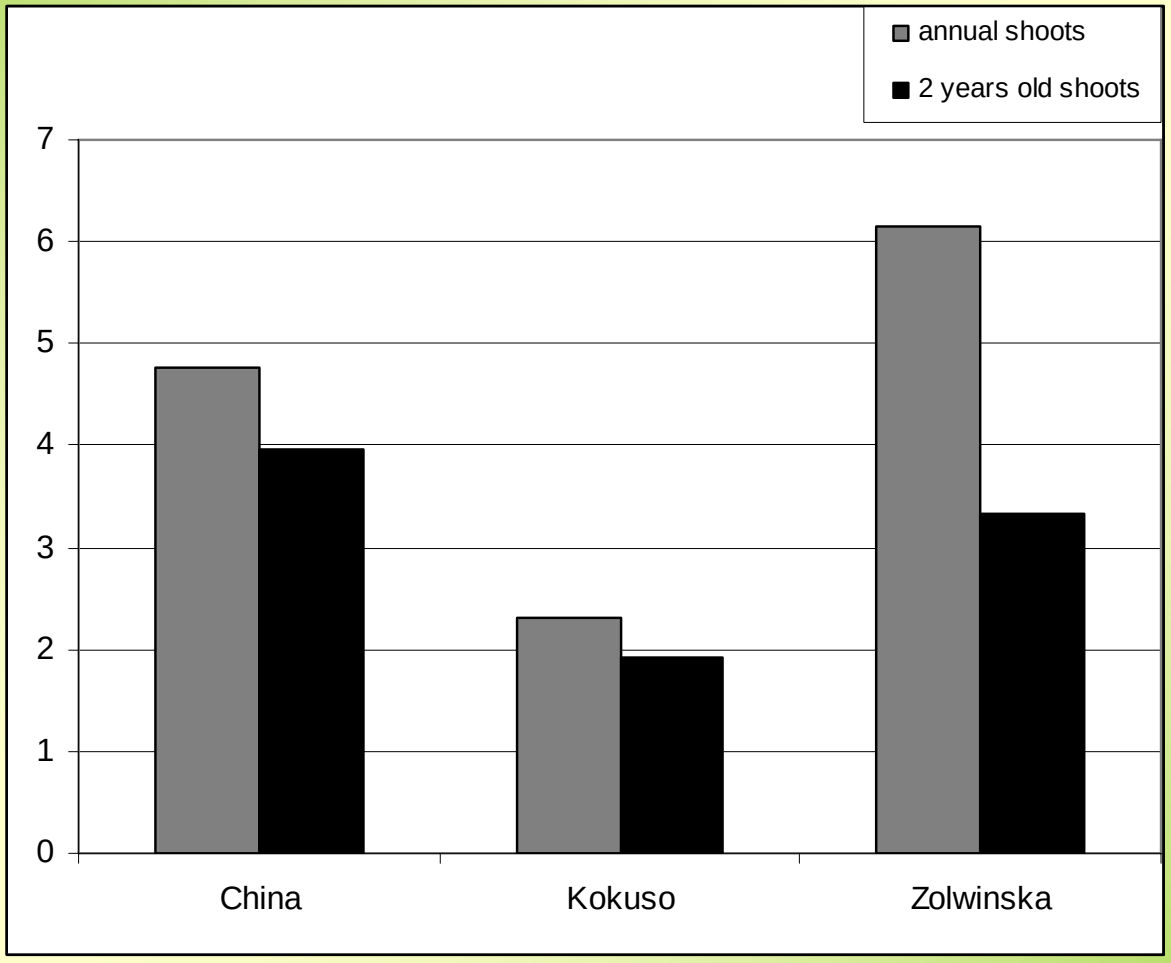
The highest pectin content was calculated for annual shoots of Zolwinska cultivar. Two years old shoots had two times smaller content of pectin.
This decreasing trend was recorded also in compared mulberries.

Results



Comparison of cellulose content of China, Kokuso and Zolwinska cultivars (in %).

Results



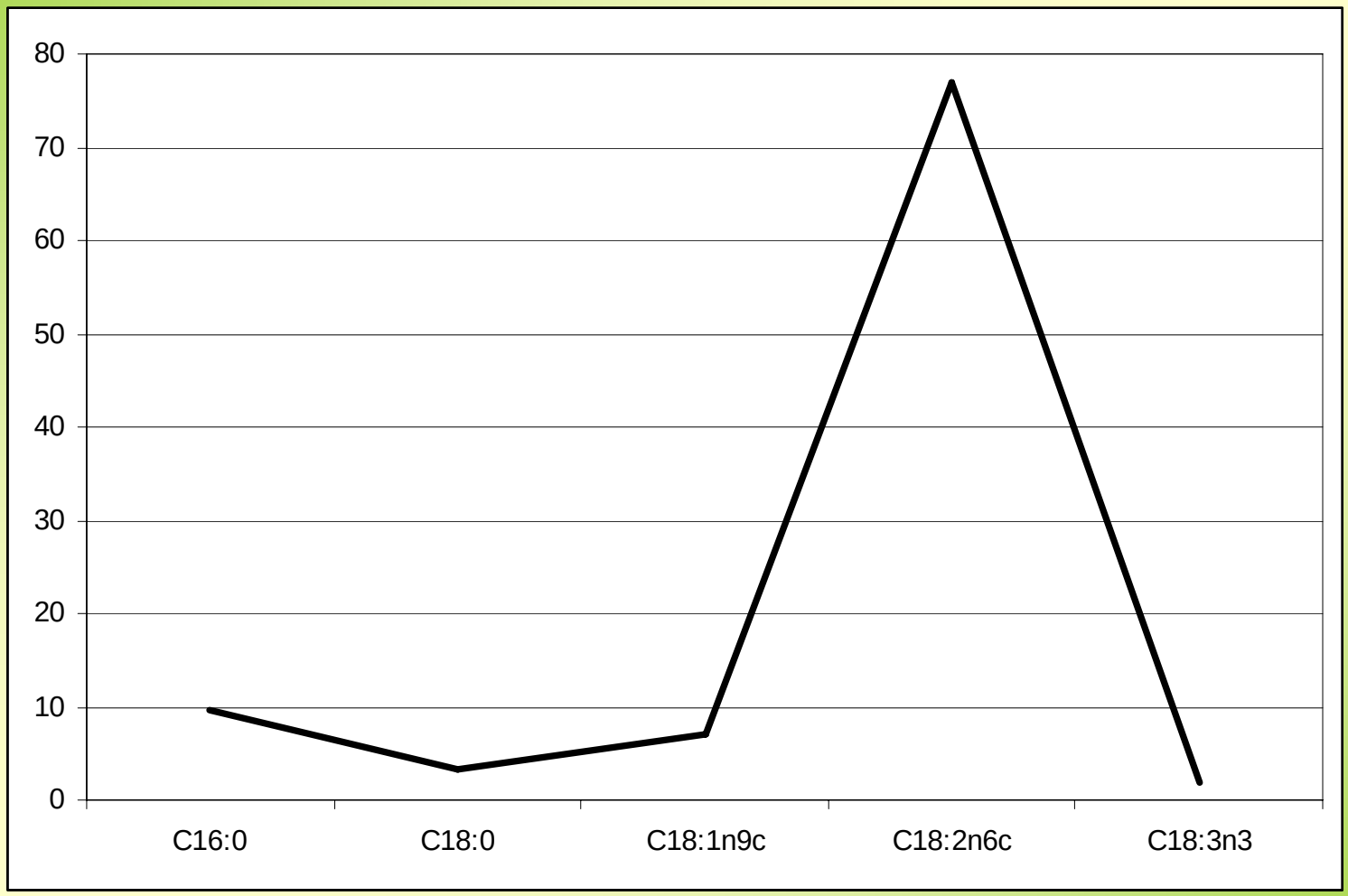
Comparison of pectin content of China, Kokuso and Zolwinska cultivars (in %).

Results

- 13 fatty acids were recorded.
- 7 are mono- and polyunsaturated fatty acids – very precious omega-3 group.
- the highest content: linoleic and oleic acid.
- trace amounts of other unsaturated fatty acids: linolenic, stearidonic, eicosadienoic, eicosanoic and erucic acid were recorded.

In consideration of this, that the mulberry seeds contain 25-35% of a yellow oil, white mulberry may used as an oil-bearing plant.

Results



Selected fatty acids content of Zolwinska cultivar (in %).

Results

- the huge energy value – 17,9 MJ/kg was recorded.
- obtaining 14-17 tones/ha of biomass.
- this energy potential, considerable resistance to disease and pests and relatively low soil requirements make the white mulberry a valuable plant for energy industry.
- mulberry plantations provide a low utilization of productive or degraded agricultural land. Therefore, it may be used to produce heat, electricity, in fuel production and as slurry in anaerobic digesters.

Zolwinska studies

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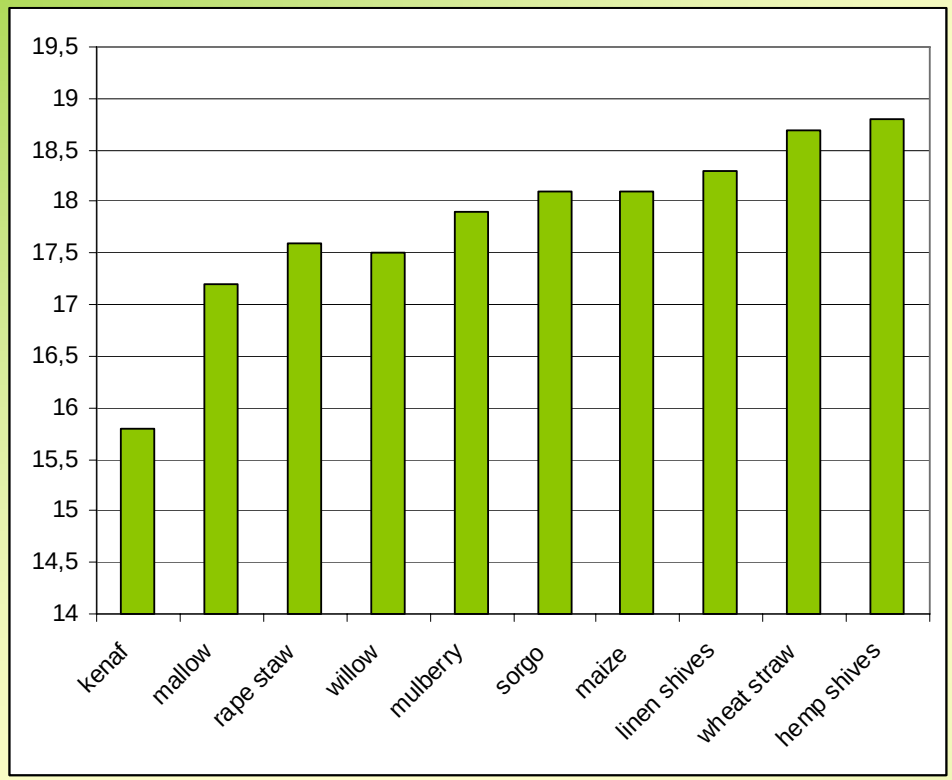
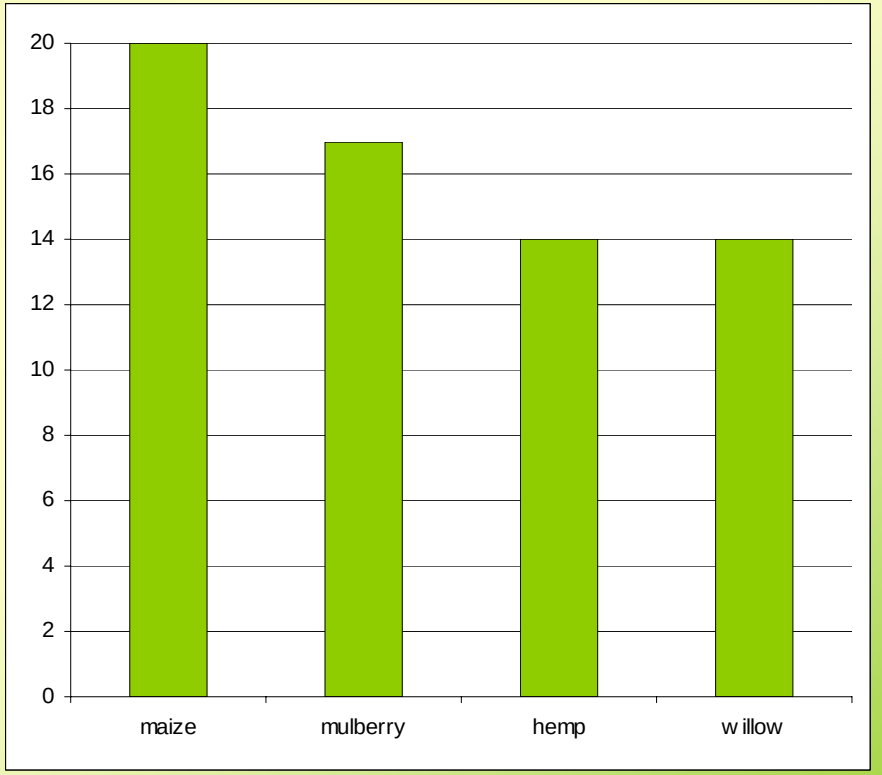


The energy value of selected, dried plant materials in MJ/kg

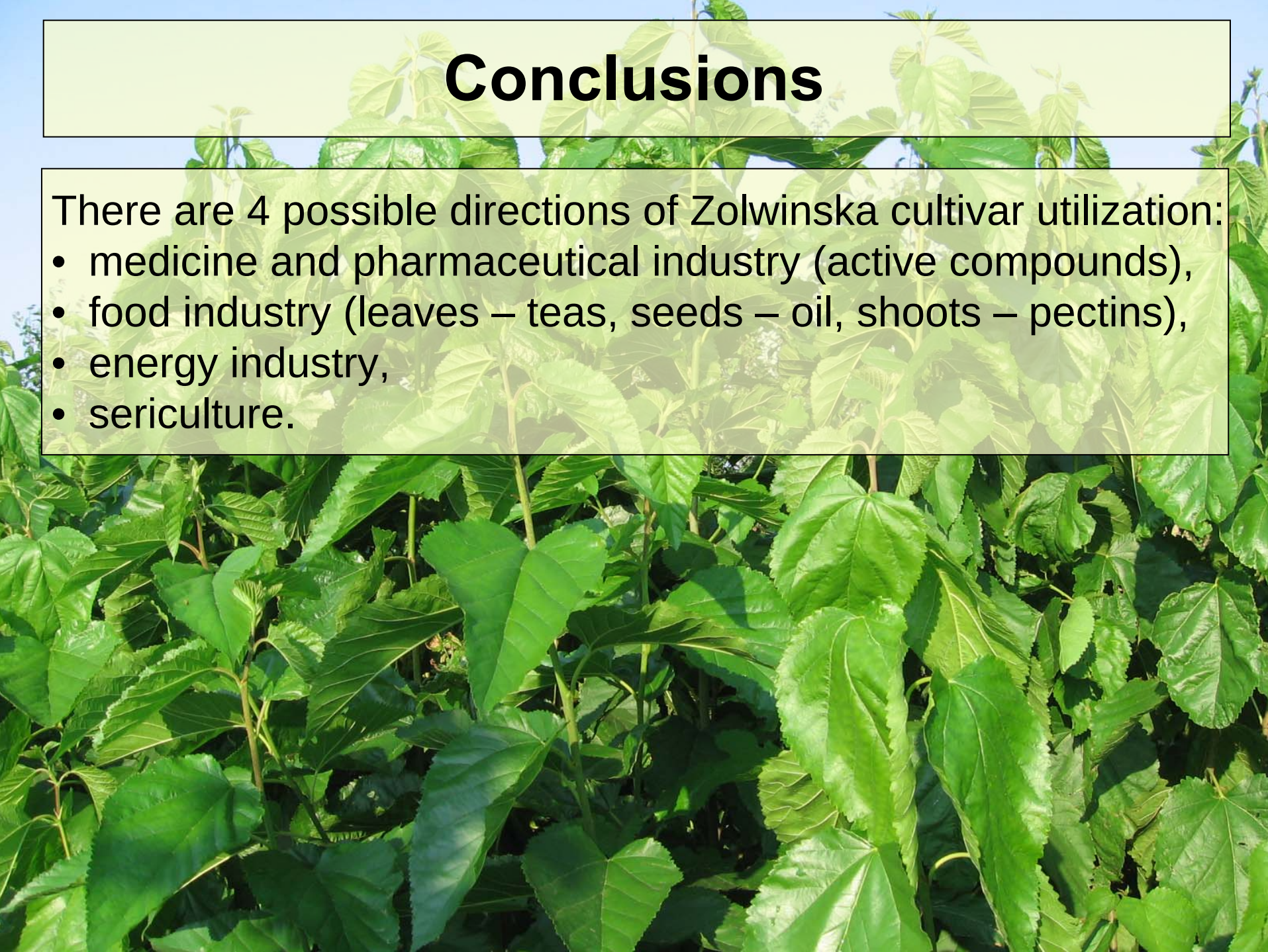


The annual biomass yield of selected plant materials in tones/ha

Conclusions

There are 4 possible directions of Zolwinska cultivar utilization:

- medicine and pharmaceutical industry (active compounds),
- food industry (leaves – teas, seeds – oil, shoots – pectins),
- energy industry,
- sericulture.




Thank you for your attention