

Department of Pharmacognosy, Medical University, Lublin¹

Department of Vegetable and Medical Plants, Agricultural University, Lublin²

AGNIESZKA LUDWICZUK¹, TADEUSZ WOLSKI^{1,2}

Estimation of the Content and Composition of Ginsenosides Occurring in Extracts from American Ginseng and Asian Ginseng

Ocena zawartości i składu ginsenozydów występujących w ekstraktach otrzymanych
z żeń-szenia amerykańskiego i żeń-szenia właściwego

Synopsis. The object of the investigations was estimation of the content and composition of ginsenosides in American ginseng (*Panax quinquefolium* L.) cultivated in climatic conditions of Lubelszczyzna (Poland). The material to study were also preparations from Asian ginseng (*Panax ginseng* C.A. Mayer). Quantitative analysis of the sum of ginsenosides recalculated onto ginsenoside Rg₁ revealed that *P. quinquefolium* root from Poland is characterized by higher concentration of ginsenosides in comparison with American ginseng from China and Canada. Percentage content of ginsenosides in the investigated *Panax ginseng* preparations was compatible with producer's requirements. The comparative TLC analysis of the composition of ginsenosides show the presence of seven standard ginsenosides in *P. ginseng* and only five in *P. quinquefolium*.

Key words: *Panax quinquefolium*, *Panax ginseng*, ginsenosides content, ginsenosides composition

INTRODUCTION

Ginseng belongs to the oldest and most popular medicinal plants. In Oriental medicine ginseng has been used for five thousand years. Nowadays, ginseng is still popular, which is proved by the number pharmaceutical preparations for people and animals present on markets. In trade there are found whole roots, the roots in cut or powdered form, dragees and capsules and tinctures, syrups or extracts. Ginseng is also present in cool drinks, as an additive in sweets and also in cosmetics, e.g., creams and shampoos (Berbeć and Dziedzic, 1996; Kitts et al., 2000).

Among the many species of ginseng, those most used in medicine are Asian ginseng (*Panax ginseng*) and American ginseng (*Panax quinquefolium*). These species differ imperceptibly in therapeutic properties (Corthout et al., 1999). Among scientists an opinion prevails that American ginseng is less stimulating. Instead, it is more effective as an agent with adaptogenic properties and as tonic against stress and in treatment of illnesses such as AIDS and tuberculosis (Sticher, 1998; Kitts et al., 2000). This results from different chemical composition of the main biologically active compounds, the ginsenosides. Asian and American ginseng roots and the preparations obtained from them, are used mainly as tonic, adaptogenic, and immunostimulant substances (Attele et al., 1999; Vanhaelen-Fastre, 2000).

In Lublin for a few years, were made investigations on cultivation and phytochemical analysis of *Panax quinquefolium* (Berbeć and Dziedzic, 1996; Ludwiczuk et al., 2002). The aim of investigations was estimation of the content and composition of ginsenosides in extracts received from *Panax quinquefolium* cultivated in Lublin (Poland) and *Panax ginseng* occurring in pharmaceutical preparations.

MATERIAL AND METHODS

The subject of the research were American ginseng roots cultivated in the Department of Industrial and Medical Plants, Agriculture University of Lublin (Poland). The materials to study were also preparations from *Panax ginseng*: *Extractum ginseng spir. spissum* (Martin Bauer, Poland) and Panaxan® (Phytopharm Kleka S.A., Poland).

1) Quantitative analysis

Determination of the sum of ginsenosides recalculated onto ginsenoside Rg₁ was made by use of spectrophotometric method according to DAB 10 (1999). 0.15 g of *Panax quinquefolium* roots, 0.20 g of *Extractum ginseng spir. spissum* and 0.30 g (1 capsule) of Panaxan® were used in the studies.

2) Qualitative analysis

Qualitative analysis of ginsenosides was made by use of TLC method. Solutions to the studies were prepared according to the method described in literature (Ludwiczuk et al., 2002).

The studies were conducted by use of 10 cm x 20 cm glass plates coated with 0.25 mm layers of silica gel Si 60 (Merck, Germany). Plates were developed to a distance of 15 cm with chloroform – ethyl acetate – methanol – water, 15 + 40 + 22 + 9 (v/v) as a mobile phase. After separation the plates were dried and sprayed with Godin's reagent (A: 5% solution of H₂SO₄ in ethanol; B: 1% solution of vanillin in ethanol). The sprayed plates were heated at 105°C for 10 min. then photographs of the plates were taken in visible light by use of VideoScanner TLC/HPLC (Camag, Switzerland).

RESULTS AND DISCUSSION

Numerical data concerning of the sum of ginsenosides recalculated onto ginsenoside Rg₁ in roots of *Panax quinquefolium* and *Panax ginseng* preparations are presented in Table 1.

Tab. 1. Percentage content of ginsenosides recalculated onto ginsenoside Rg₁ in *P. quinquefolium* roots and *P. ginseng* preparations (SD for n = 4)

Studied material	Received results [%]	Literature data/producer requirements
<i>P. quinquefolium</i> roots	12.53 ± 0.06	not more than 10% (Peigen, 1989) 3.24-4% (Ma et al., 1990) 3-5% (Berbeć and Dziedzic, 1996)
<i>Extractum Ginseng spir. spissum</i>	17.92 ± 0.79	not less than 12%
Panaxan®	4.99 ± 0.30 (14.98 ± 0.90 mg/capsule)	from 3% to 5% (min. 9 mg/capsule)

As it follows from Table 1, the content of ginsenosides in American ginseng roots amounted to 12.53%. In comparison to literature data on the content of ginsenosides in *Panax quinquefolium* roots from Canada and China, American ginseng cultivated in climatic conditions of Lubelszczyszna (Poland) is characterized by higher concentrations of saponosides. Percentage content of ginsenosides in the studied *Panax ginseng* preparations was compatible with producer's requirements and amounted to *Extractum ginseng spir. spissum* – 17.92%; Panaxan® – 4.99% (14.98 mg/capsule).

Tab. 2. R_f values for standard ginsenosides and spots of identified compounds in the studied raw material and preparations

Name of compound	R _f standard	R _f <i>Extractum ginseng spir. spissum</i>	R _f Panaxan®	R _f <i>P. quinquefolium</i> root
Rb ₁	0,15	0,15	0,15	0,15
Rb ₂	0,18	0,18	0,18	-
Rc	0,21	0,21	0,21	0,21
Re	0,24	0,24	0,24	0,24
Rd	0,28	0,28	0,28	0,28
Rg ₁	0,33	0,33	0,33	0,33
Rf	0,37	0,37	0,37	-

Results from TLC analysis are illustrated in Figures 1a, 1b and 2 and in Table 2. The presented data indicate the presence of 10 bands for Panaxan® and 9 bands for *Extractum ginseng spir. spissum* and *Panax quinquefolium* roots.

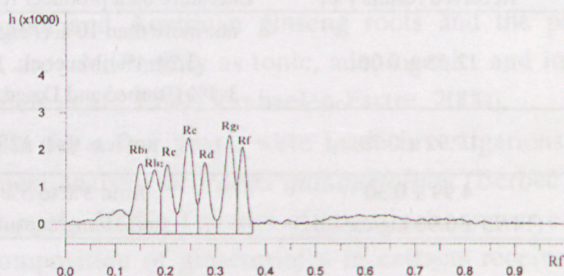
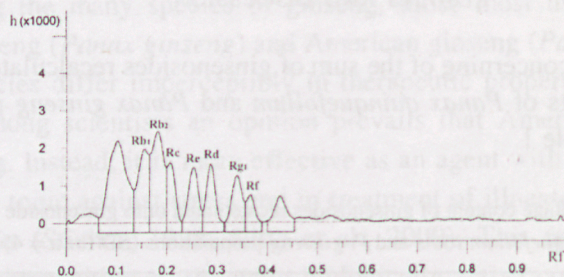


Fig 1a. Chromatogram of the ginsenosides occurring in *Panax ginseng* preparations
(a) *Extractum ginseng spir. spissum*; (b) standards

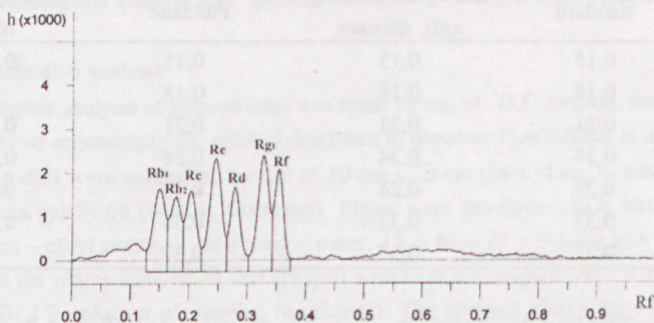
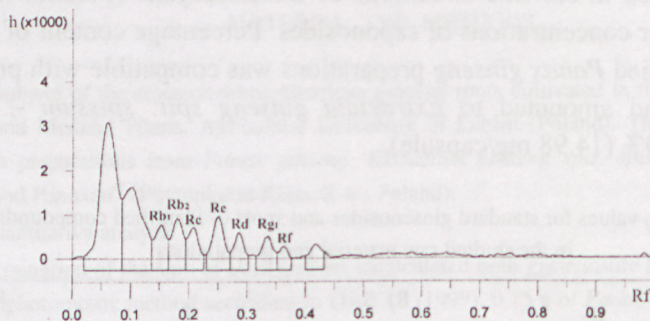


Fig. 1b. Chromatogram of the ginsenosides occurring in *Panax ginseng* preparations
(a) *Panaxan*; (b) standards

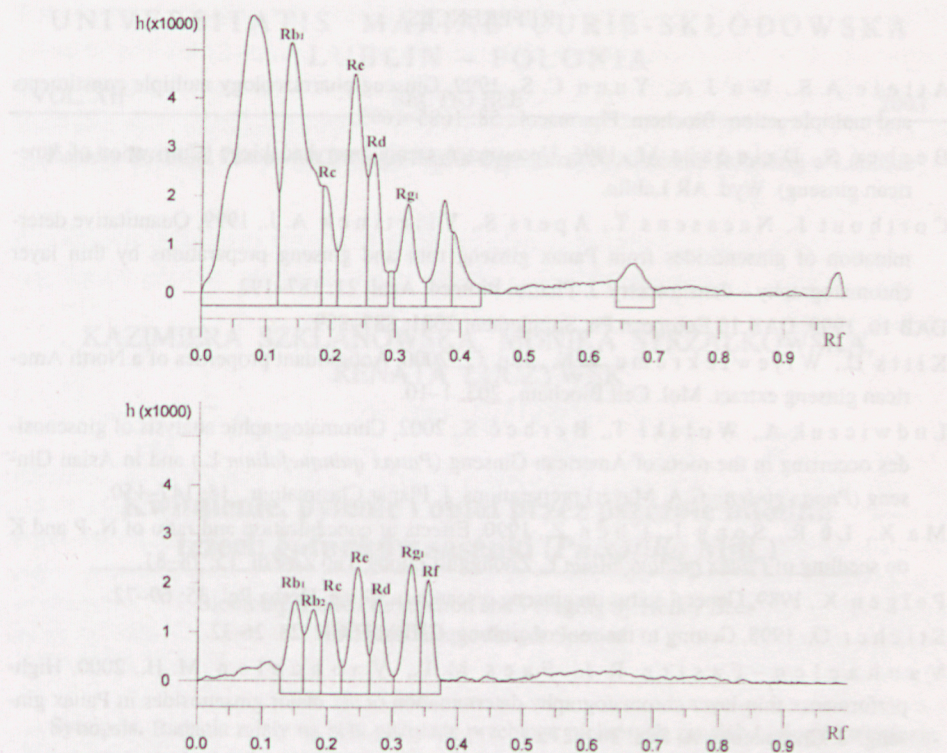


Fig. 2. Chromatogram of the ginsenosides occurring in *Panax quinquefolium*
(a) *Panax quinquefolium*; (b) standards

Bands corresponding to the standard ginsenosides: Rb₁, Rb₂, Rc, Re, Rd, Rg₁ and Rf were observed from both of the examined *Panax ginseng* preparations. In American ginseng roots no ginsenosides Rb₂ and Rf were found. According to European Pharmacopoeia (2001), absence of ginsenoside Rf on TLC chromatogram differentiates *Panax quinquefolium* from *Panax ginseng*.

CONCLUSION

1. The content of ginsenosides in the roots of *Panax quinquefolium* cultivated in climatic conditions of Lubelszczyzna (Poland) amounted to 12.53%. *Panax ginseng* preparations meet producer's requirements applying to the content of ginsenosides.

2. TLC analysis of Asian ginseng preparations shows presence of bands corresponding to seven standard ginsenosides. The analysis also shows absence of ginsenoside Rf in American ginseng roots. It is in accordance with European Pharmacopoeia.

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STRESZCZENIE

Celem przeprowadzonych badań było oznaczenie zawartości i składu ginsenozydów występujących w korzeniach żeń-szenia amerykańskiego (*Panax quinquefolium* L.) uprawianego w warunkach klimatycznych Lubelszczyzny. Przedmiotem badań były także preparaty farmaceutyczne z żeń-szenia właściwego (*Panax ginseng* C.A. Mayer), tj. *Extractum Ginseng spir. spissum* i Panaxan®. Analiza ilościowa sumy ginsenozydów w przeliczeniu na ginsenozyd Rg₁ wykazała, że korzenie żeń-szenia amerykańskiego charakteryzują się wysoką zawartością saponozydów w porównaniu do żeń-szenia pięciolistnego pochodzącego z Chin czy Kanady. Procentowa zawartość ginsenozydów w badanych preparatach z żeń-szenia właściwego była zgodna z wymaganiami producentów. Porównawcza analiza TLC składu ginsenozydów wykazała obecność siedmiu wzorcowych ginsenozydów w *P. ginseng* i pięciu w *P. quinquefolium*.