Krzysztof Kluk's 'Dykcyonarz roslinny' as an example of phytotherapeutical science development in 18th century Poland: A contribution to European heritage

By: Sekara, A (Sekara, Agnieszka)[1]; Kalisz, A (Kalisz, Andrzej)[1]; Gruszecki, R (Gruszecki, Robert)[2]; Mehrafarin, A (Mehrafarin, Ali)[3]

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Abstract

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Author Information

Reprint Address: Sekara, A (reprint author)

+ Agr Univ Krakow, Dept Vegetable & Med Plants, 29 Listopada 54, PL-31425 Krakow, Poland.

Addresses:

+ [1] Agr Univ Krakow, Dept Vegetable & Med Plants, 29 Listopada 54, PL-31425 Krakow, Poland

+ [2] Univ Life Sci Lublin, Dept Vegetable Crops & Med Plants, Leszczynskiego 58, PL-20068 Lublin, Poland

+ [3] ACECR, Inst Med Plants, Med Plants Res Ctr, Karaj, Iran

E-mail Addresses: a.sekara@ur.krakow.pl; a.kalisz@ur.krakow.pl; robert.gruszecki@up.lublin.pl; Mehrafarin@imp.ac.ir

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Research paper

Krzysztof Kluk's 'Dykcyonarz roślinny' as an example of phytotherapeutical science development in 18th century Poland: A contribution to European heritage

Agnieszka Sękara[a,*], Andrzej Kalisz[a], Robert Gruszecki[b], Ali Mehrafarin[c]

[a] Department of Vegetable and Medicinal Plants, University of Agriculture in Krakow, 29 Listopada 54, 31-425 Kraków, Poland
[b] Department of Vegetable Crops and Medicinal Plants, University of Life Sciences in Lublin, Leszczyńskiego 58, 20-068 Lublin, Poland
[c] Medicinal Plants Research Centre, Institute of Medicinal Plants, ACECR, Karaj, Iran

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ABSTRACT

'Dykcyonarz roślinny' ('Dictionary of Plants') by Krzysztof Kluk, published in 1786 (Vol. I), 1787 (Vol. II), and 1788 (Vol. III), contains the descriptions of 1598 species of algae, fungi and plants, to a large extent with their therapeutic and utilitarian value. The goal of this study was to present 'Dykcyonarz roślinny' as an important contribution to the European botanical heritage of the Age of Enlightenment. The accession of the state of knowledge in the area of herbal medicine was studied with analysis of the monographs of selected medicinal species described in 'Dykcyonarz roślinny' against their historical and contemporary therapeutic relevance. Monographs were developed based on Krzysztof Kluk's own scientific experience, supplemented by bibliographic references to ancient authors, 16th and 17th century botanists and Kluk's contemporary researchers. The novelty of the 'Dykcyonarz' was the regularisation of Polish nomenclature and the simultaneous application of the Linnaean classification system of plants. For the first time in the history of Polish botanical literature, Kluk used comprehensive knowledge of the morphology, anatomy and physiology of plants. He proposed accurate and comprehensible naming of the morphological parts of plants, enabling their precise descriptions. Information on the therapeutic use of herbs is mostly confirmed by modern scientific research. 'Dykcyonarz roślinny' by Krzysztof Kluk played an important role in systematising, improving and popularising the knowledge of medicinal plants and incorporated unique ethnobotanical information valuable to modern scientists.

1. Introduction

Since the mid-1700s, post-Linnaeus scholars developed an international genre of botanical works based on empirical data and devoted to improving the quality of human life and health (Svanberg et al., 2011). Linnaeus' topographical works were the role models for ethnobotanical and ethnozoological scientific studies focussed on both the Old and the New World. Among the most important apostles of Carl Linnaeus, Svanberg et al. (2011) mentioned Swedish botanists Peter Kalm (1716–1779), who explored Sweden, Russia and North America, and Johan Peter Falck (1732–1774), who headed an expedition into Siberia and Kazan. English naturalist John Lightfoot (1735–1788) pioneered the scientific study of the plants and fungi of Scotland; Spanish doctor and botanist José Quer y Martínez (1695–1764) explored the flora of Spain, France, Italy and northern Africa; and Portuguese botanist Félix de Avelar Brotero (1744–1828) published the first detailed descriptions of native Portuguese plants. The common use of the French language in high societies in the 18th century, and excellent knowledge of books from Paris created favourable conditions for French botanists. Brothers Bernard (1699–1777) and Antoine Laurent (1686–1758) de Jussieu worked on the systematics of the flora of France, Spain and Portugal, Dominique Villars (1745–1814) explored the flora of the Alps, and Jean-Emmanuel Gilibert (1741–1814) described flora of Lithuania (Svanberg et al., 2011; Beauvois, 2015).

At the same time, in Poland, the priest Krzysztof Kluk (1739–1796) became famous as an author of works that contributed to the development of the natural sciences, which were the basis for civilisation progress in Europe. Kluk was born and worked in Ciechanowiec, in the region of Podlasie, in the north-west region of present-day Poland. His wide botanical knowledge was a result of self-learning, observations of nature, conversations with practitioners and his own experiments. Kluk knew Latin, German and French, so he could study original works of ancient authors and 16–17th-century European botanists. Thanks to friendships with enlightened magnate families, the Ossoliński and the

* Corresponding author.
E-mail addresses: a.sekara@ur.krakow.pl (A. Sękara), a.kalisz@ur.krakow.pl (A. Kalisz), robert.gruszecki@up.lublin.pl (R. Gruszecki), Mehrafarin@imp.ac.ir (A. Mehrafarin).

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Jabłonowski, Kluk had the opportunity to make use of rich libraries and natural history collections (W & jcik, 2000; Bajno et al., 2010). Not only did Kluk work in the field of botanical sciences, he was also interested in zoology, forestry, geology, and the technology and economics of agriculture, among other subjects. Therefore, widespread education and areas of interest gave him a basis for the elaboration of 14 volumes of works of natural science, printed between 1777 and 1789 (Bajno et al., 2010). One of the most important of Kluk's works is 'Dykcyonarz roślinny' ('Dictionary of Plants'), recognised as the first Polish plant encyclopaedia (Wójcik, 2000).

Kluk addressed the work to the general public, so he used a form of a dictionary, which was popular during the Age of Enlightenment. The work contains a progressive look at the role of plants in the world and the economics of nature – that is, taking care to preserve the natural balance. A significant element of the 'Dykcyonarz roślinny' refers to knowledge about medicinal plants and their therapeutic use. The author put together information from this area, both in a general form within the prologue, as well as in a detailed form within monographs of individual species. 'Dykcyonarz roślinny' was the first herbarium in old Polish literature that exhaustively presented the flora of the New World (Elbanowski, 2014).

In recognition of his achievements, Kluk received the degree of doctor of philosophy and liberal sciences and a membership of the Collegium Physicum of the University of Wilno. In spite of the merits of Kluk's work, he is still undervalued among famous European naturalists. The promulgation of this study could be a Polish contribution to the European cultural heritage in a field of widely defined ethnography.

The goal of this study is to assess the state of knowledge in the area of herbal medicine presented by Krzysztof Kluk in 'Dykcyonarz roślinny' through analysis of the monographs of selected medicinal species, referring to their contemporary therapeutic relevance.

2. Materials and methods

2.1. The historical source criticism method

The historical source criticism method proposed by Topolski (1977) was used. The studied material was Kluk, K. (1786–1788) 'Dykcyonarz roślinny' ('Dictionary of Plants'), published by Printing House of Xięży Piarów, Warsaw, Poland. Reproductions of original editions are available on the Internet as digital images (http://starodruki.miiz.waw.pl (1786–1788 edition); http://www.kpbc.ukw.edu.pl (1805–1808 edition)), but documents were also personally consulted and subsequent editions compared. Erudite (external, lower) criticism together with hermeneutics (internal, higher criticism) was applied to the study of the reliability of informants and information. The main goal of both the external and internal source criticism is also the proper interpretation of the text, to verify the authenticity of the information provided by the author based on his psychological and sociological background. Psychological interpretation allows explanation for the reasons of a historical fact, and sociological interpretation enables interpretation of works against historical period.

2.2. Detailed study of internal arrangement and substantive content of 'Dykcyonarz roślinny'

The subject of the study was the internal arrangement of Krzysztof Kluk's 'Dykcyonarz roślinny' ('Dictionary of Plants'), 1786 (Vol. I), 1787 (Vol. II), and 1788 (Vol. III). Monographs of all species were studied with respect to nomenclature, classification, taxonomic status, origin, therapeutic and utilitarian use. Plant names and classification were crosschecked with The International Plant Names Index (http://ipni.org/), the USDA's Germplasm Resources Information Network (GRIN) online database (http://www.ars-grin.gov/cgi-bin/npgs/html/tax_search.pl), the Global Biodiversity Information Facility (GBIF) (http://www.gbif.org/) and The Algae Base (http://www.algaebase.org/about/). Fungi names were crosschecked with The Index Fungorum database (http://www.indexfungorum.org/). The numbers of plant families, genera, and species were calculated according to Kluk, and current classification verified.

The species were classified with respect to origin into three main categories: (i) species native to Europe; (ii) species of Asian and African origin, known from ancient times in Europe thanks to the Roman and Islamic spice trade; (iii) plants of New World origin, imported to Europe in the Age of Discovery. Therapeutic uses reported by Kluk were interpreted and organised according to the database of herbal actions proposed by Bone and Mills (2013). The number of species showing a particular therapeutic action was calculated. Additionally, the number of species with utilitarian value reported by Kluk (dyes, honey plants, pasture) was juxtaposed.

2.3. Detailed study of monographs of selected species

The subjects of the study were the selected monographs of medicinal plants in Krzysztof Kluk's 'Dykcyonarz roślinny'. Three herbs from each of three categories were sought in an attempt to discover similarities and differences between descriptions by Kluk and modern uses, according to the methodology proposed by Thomas (2011). The categories were (i) species native to Europe: Absinthe wormwood (*Artemisia absinthium* L.), common foxglove (*Digitalis purpurea* L.) and tormentil (*Potentilla erecta* (L.) Raeusch.); (ii) species of Asian origin: camphor (*Cinnamomum camphora* (L.) J. Presl); turmeric (*Curcuma longa* L.) and ginger (*Zingiber officinale* Roscoe); and (iii) plants of New World origin: quinine (*Cinchona officinalis* L.), jalap (*Ipomoea purga* (Wender.) Hayne) and sarsaparilla (*Smilax* sp. L.). All species mentioned were accredited as medicinal and included in the Pharmacopoeia Regni Poloniae (1817). The authors aimed to sample species representative of the internal composition and substantive value of 'Dykcyonarz roślinny' and, at the same time, varying in origin, botanical, phytochemical and utilitarian characteristics. With the use of these monographs, we propose an idea to show the innovation and scientific exceptionalism of Kluk's work.

3. Results and discussion

3.1. K. Kluk's 'Dykcyonarz roślinny' internal arrangement

The first edition of Krzysztof Kluk's 'Dykcyonarz roślinny' is composed of three volumes, published in 1786, 1787 and 1788. The first chapter of Vol. I is an introduction, which contains a brief description of the work, an explanation of the scheme and the order of described species. Kluk incisively signals to the reader that the species described in the 'Dykcyonarz roślinny' are the result of many years of his own observations, but only in the Podlasie region. He demonstrated skills of generalisation through making hypotheses on the similar morphology and pharmacological use of plants in old Poland. Kluk explained the use of the Linnaean classification system as common among botanists in the 18th century. He also explained that he followed the Herbarium of Szymon Syreński (Syreński, 1613) as a source of Polish plant names. The new species were translated from other languages or invented by Kluk himself. With respect to medicinal plant usage, Kluk declared that he dispensed with traditional and unverified data and focussed on the contemporary experiences of Johann Friedrich Gmelin (1748–1804), Johann Gottlieb Gleditsch (1714–1786), Anton von Störck (1731–1803), Samuel Auguste Tissot (1728–1797), Johann Friedrich Zückert (1737–1778) and others. It should be underlined that Kluk dedicated his work to a wide spectrum of readers, so the form of a dictionary was the most appropriate and intelligible for the Polish general public of those days. Also, Grębecka (2000) underlined that the out-of-date internal arrangement of 'Dykcyonarz roślinny' is not proof of backwardness or relative scientific unsophistication of Kluk but that the layout was well adjusted to social and cultural conditions in 18th

century Poland. The introduction can be recognised as the detailed and professional methodology of 'Dykcyonarz roślinny' management.

The following part of Vol. I of 'Dykcyonarz roślinny' is the description of 567 species arranged alphabetically from A to E. Plants were divided into genera according to the Linnaean system and numbered analogously to 'Genera Plantarum' with the use of abbreviations L.G. = *Linnei Genus* or L.M. = *Linnei Mantissa*. Native species were presented by Kluk in alphabetical order and divided according to their origin. The position of species described in a further part of this paper was supplemented with Kluk's original numbers. Released in 1787, Vol. II includes 610 species beginning with the letters F to Q. The third volume (Vol. III) (1788) contains descriptions of 359 species from the letter R to Z, and 62 species in the Supplement, as well as the Registry of plant names', 'Registry of useful plants', 'Registry of medicinal plants' and 'Divisions, orders and genera'. The 'Registry of plant names' contains an alphabetical list of Polish and Latin names of plants described in the work. 'Registry of useful plants' is a collection of the lists and categories for the different ways in which plants can be used. 'Registry of medicinal plants' contains 143 morbid entities and their treatment, allocated to specific plant species. 'Divisions, orders and genera' represents a very useful key for plant identification, with a short instruction from the author.

To summarise, Kluk included in 'Dykcyonarz roślinny' monographs of 1497 species of kingdom Plantae and 101 species of Fungi. In the subsequent discussion, monographs of 1397 species of the embryophyte group (including ferns, lycophytes, gymnosperms and flowering plants) were considered with respect to evidenced classification, utilitarian importance and pharmacological activity. These species represent 143 families (150 according to prevailing classification) and 530 genera (683 according to prevailing classification). Among the 1397 embryophytes mentioned by Kluk, 52 names were identified as synonyms, and 16 as without a status accepted in databases used for crosschecking of nomenclature, and were therefore excluded from further elaboration.

Within particular genera, Kluk only described species known by him directly and observed in natural habitats, gardens or greenhouse collections. He characterised morphology, time of flowering, growth habit, duration, habitat or place where he observed individuals, origin of the species and practical application.

Kluk described the pharmacological activities – often multidirectional – of 526 species. The percentages of species with particular pharmacological activity (presented in alphabetical order) is as follows: analgesic and local anaesthetic, 10.5; antidiarrhoeal 9.0; anti-inflammatory 19.0; antilithic 6,7; antiseptic, antimicrobial and antiparasitic 15.4; anti-oedematous 9.9; antipyretic 14.3; antiscorbutic 11.6; antispasmodic 11.4; antiulcer 6.5; aperient and laxative 13.0; astringent 16.0; bitter tonic and gastric stimulant 11.8; diaphoretic 8.6; diuretic and diuretic depurative 15.2; emmenagogue 5.7; expectorant 5.5; healing promoter and vulnerary 23.8; hepatic tonic 6.7; antituberculosis, in pulmonary diseases treatment 18.5; mucolytic 7.2; nervine tonic and neuroprotective 13.0; pungent 8.6; refrigerant 10.9; uterine tonic 7.4. Other pharmacological activities (antacid, anti-asthmatic, antihaemorrhagic, antirheumatic, antitumour, antitussive, aphrodisiac, cardiotonic and cardioprotective, carminative, demulcent, emetic, immune enhancing, kidney tonic, metabolic stimulant, nutrient, parturifacient, spleen tonic and urinary antiseptic) characterised 1–5% of species mentioned. This statement reflects the general health status of the population in Europe in the centuries preceding the creation of 'Dykcyonarz roślinny'. The main sources of high mortality varied by country, but typically included airborne diseases (diphtheria, whooping cough, measles, smallpox and scarlet fever), waterborne diseases (cholera, diarrhoea, dysentery and typhus), and tuberculosis (Liczbińska, 2010). Native herbal remedies were believed to be the only available medicine for the majority of the population, especially in rural communities. Kluk recognised the poor knowledge of his readers about the diseases' aetiologies so he focussed on linking commonly known diseases, symptoms or organ disorders to herbal remedies. His attention to public health found expression in the pointing out of native substitutes for expensive imported medicines. For example, bark of *Salix* sp. L., herb of *Centaurium erythraea* Rafn., root and leaf of *Alchemilla xanthochlora* Rothm., seed of *Aesculus hippocastanum* L., rhizome of *Phragmites australis* (Cav.) Trin. ex Steud., or leaf of *Cinchona pubescens Vahl* (L.) Gaertn. were pointed out as quinine (*Cinchona officinalis* L. bark) substitutes. Roots of *Arctium lappa* L., *Carex arenaria* L., *Saponaria officinalis* L., and *Solanum dulcamara* L. were described as sarsaparilla (root of *Smilax* spp.) substitutes. It is worth emphasising that native poisonous plants (42 species) were described in detail with respect to morphology, natural habitat, distribution and their differences from similar usable species, to avoid mistakes. Poor economic performance and chronic malnutrition was a major factor in the high mortality rates prevailing before the 19th century (Acemoglu et al., 2003). Kluk appreciated the importance of extending the diversity and productivity of crops cultivated in Poland for the maintenance of food supply. He dedicated a lot of space in his monographs on introduced or less popular crops to the description of modern varieties, cultivation and processing techniques and nutritional value. He also featured species of economic importance and value for households and farms, such as plant dyes (ca. 80 species), honey plants (180) and pastures (90), etc. Kluk focussed on native flora as being the most accessible, but also he was the first Polish botanist to describe 71 New World species.

3.2. Monographs of species native to Europe

3.2.1. *Artemisia absinthium* L.

Family: Asteraceae Bercht. & J. Presl

Common name: absinthe wormwood

Latin and Polish name in Kluk's 'Dykcyonarz Roślinny' (Vol. I, item 120): *Artemisia absinthium* – Bylica piołun

The genus *Artemisia* L. is one of the largest and most widely distributed genera of the family Asteraceae. For centuries, *Artemisia* species have commonly been used as medicinal and aromatic plants in many countries of Europe, Asia and North America (Bora and Sharma, 2010). Kluk included in 'Dykcyonarz' monographs of five species of this genus which he studied himself: southernwood (*A. abrotanum* L.), field wormwood (*A. campestris* L.), absinthe wormwood (*A. absinthium* L.), common wormwood (*A. vulgaris* L.) and tarragon (*A. dracunculus* L.). The monograph of *A. absinthium* started with a correct botanical description of the species and its distribution. According to Kluk, the active constituents of *A. absinthium* are the leaves and flowers, which can be applied as a diaphoretic, gastric stimulant, antiseptic and antiparasitic. Aromatic oils were described by Kluk as the most effective for external anti-parasitic action. In addition, *A. absinthium* water extracts can be used for elimination of insects from houses and as an antidiarroheal remedy, notably suitable for sheep.

The Polish botanist Syreński (1613) dedicated much more attention to this species in his study 'Zielnik' ('Medicinal Plants'). He described formulae of mixtures containing *A. absinthium*, indicated mainly for stomach and liver disorders, but also for infectious diseases, such as dysentery and ague. The author indicated *A. absinthium* as an antidote for many poisons due to its emetic activity. Compression with an infusion was prescribed for inflammation, fatigue and infections of the eyes. The author also included a broad description of veterinary applications of this herb. According to present ethnopharmacological studies, *A. absinthium* has traditionally been used in Europe for the treatment of a much wider spectrum of diseases, including as an anthelmintic, antiseptic, antispasmodic, febrifuge, stomachic and cardiac stimulant; for restoration of declining mental function and inflammation of the liver; and for improving memory (Wake et al., 2000; Howes et al., 2003; Guarrera, 2005). Such activity of *A. absinthium* was described also by Pliny the Elder (Pliny the Elder, 1855). *A. absinthium* applications described in references available for Kluk (as above mentioned, Pliny the Elder and Syreński) justified the conclusion that only the most widely known uses of this species were noted in 'Dykcyonarz

roślinny'. This can be explained by the most current ordering of the *Artemisia* taxonomy and by linking the previous knowledge of pharmacological usage to particular species of this genus like *A. abrotanum*, *A. campestris*, *A. vulgaris* and *A. dracunculus*. The description of the *Artemisia* genus is an example of Kluk's achievements in the field of ordering of medicinal plant taxonomy and usage. This monograph is also an example of Kluk's corrections of mistakes resulting from improper interpretation of earlier botanical and pharmacological studies, reported, for example, by Marcin of Urzedowo (1595).

Present reports indicate that chronic use of *A. absinthium* can cause some neurotoxic effects due to the presence of thujone and its derivatives. Ethnobotanical sources did not point to such implications, probably due to the low probability of exceeding the threshold concentrations of thujone. Lachenmeier (2010) discussed *A. absinthium* as a curious plant with both neurotoxic and neuroprotective properties. Kluk proposed few dosage forms of *A. absinthium*, but he declared that the most effective internal dosage forms are wine and beer extracts. Present investigations of Singh et al. (2012) showed that an ethanolic extract of *A. absinthium* has significantly higher concentrations of flavonoid, phenolic and tannin contents compared to aqueous and chloroform extracts. Therefore, ethanolic extracts have greater potential to scavenge free radicals and can produce more beneficial effects compared to aqueous and chloroform extracts. This information, linked to the neuroprotective action of *A. absinthium* discussed by Lachenmeier (2010), can explain the prescribing of *A. absinthium* tinctures for neurasthenia in the ethnopharmacological literature (e.g., Syreński, 1613).

According to the present state of knowledge, *A. absinthium* herb contains terpenoids, flavonoids, coumarins, polyphenolics, caffeoylquinic acids, sterols and acetylenes. *A. absinthium* has been reported to have a broad spectrum of inhibitory activity against a variety of microorganisms due to the presence of essential oils containing chamazulene, nuciferol butanoate, nuciferol propionate, caryophyllene oxide, phellandrene, pinene and azulene (Juteau et al., 2003). The results of a study by Amat et al. (2010) strongly emphasised the protective effect of aqueous extracts of *A. absinthium* against acute liver injury, which may be attributed to the extract's antioxidative and/or immunomodulatory activity, and thereby scientifically support their traditional use.

3.2.2. *Digitalis purpurea L.*

Family: Plantaginaceae Juss.

Common name: foxglove

Latin and Polish name in Kluk's 'Dykcyonarz Roślinny' (Vol. I, item 467): *Digitalis purpurea* – Naparstnica czerwona

Common foxglove (*D. purpurea*) is the best-known species of the genus *Digitalis* L. Native to Europe, it was widely used in mediaeval Europe for effective treatment of dropsy or the swelling of tissue; nevertheless, it was never mentioned by Dioscorides, Theophrastus or other ancient writers. The name *Digitalis* was given to the plant in 1542 by the German Leonard Fuchs (1501–1566) as a translation of the German word for 'fingerhut' or 'thimble', which describes the shape of the flowers. Fuchs described this plant as purgative and emetic, being aware of the diuretic-like action of foxglove extracts (Rietbrock and Woodcock, 1985; Somberg et al., 1985). In 1650, *D. purpurea* was included in the London Pharmacopoeia; however, it failed to maintain its foothold in therapy because of its prohibitive toxicity (Somberg et al., 1985). Kluk also quoted the Dutch physician Herman Boerhaave's (1668–1738) opinion on the poisonous character of *D. purpurea* and described its toxic symptoms, including vomiting and stomach disorder. It is interesting that Kluk described also the curative properties of *D. purpurea* when applied in low doses. Oral ingestion was prescribed in the treatment of dropsy, poultices against dropsy (oedema), abscess, gout and rachitis. In those times, any link between oedema and heart disease was not known. This was the reason why many misconceptions appeared among 16th and 17th century pharmacologists, who used *Digitalis* successfully in one case and unsuccessfully in another, until it gained the reputation of being toxic, as confirmed in Herman Boerhaave's works (Panda, 2002). Kluk's 'Dykcyonarz roślinny' was published contemporaneously to William Withering's monograph 'An account of the foxglove and some of its medical uses' (1785). Withering recognised the usefulness of *D. purpurea* extracts for the treatment of dropsy, the term used for myocardial insufficiency, but Kluk did not link the action of *D. purpurea* with heart disease. In the early 20th century, it became accepted that the primary effect of *D. purpurea* was on the heart, and the glycosides were useful as anti-arrhythmics for treating atrial fibrillation and flutter as well as for enhancing the contractility of myocardial muscular tissue in the treatment of cardiac failure (Soldin, 1986). *D. purpurea* was not included in 16th and 17th century Polish botanical and medical works, so including this species among the medicinal plants of 'Dykcyonarz roślinny' supported the current status of the pharmacological knowledge of Krzysztof Kluk. In addition to *D. purpurea*, Kluk also included in 'Dykcyonarz roślinny' a monograph of yellow foxglove (*D. lutea* L.).

3.2.3. *Potentilla erecta (L.) Raeusch.*

Family: Rosaceae Juss.

Common name: tormentil

Latin and Polish name in Kluk's 'Dykcyonarz Roślinny' (Vol. III, item 1360): *Tormentilla erecta* – Kurze ziele stojące

The genus *Potentilla* L. includes about 500 species of perennial, rarely biennial and annual herbs and small shrubs with rhizomes. The name of the genus comes from the Latin *potens* meaning 'powerful', in reference to the medicinal properties of the species. *P. erecta* is native to Europe and western Asia; its rhizomes were traditionally used as medicine, food and dye (Ivancheva and Stantcheva, 2000; Tomczyk and Latté, 2009).

In addition to a detailed botanical description of the species, Kluk described the pharmacological utilisation of its rhizomes, but he focussed most attention on the use of rhizomes as natural dyes, which can be a cheaper substitute for dragon's blood (*Daemonorops draco* (Willd.) Blume). Rhizome powder extract was used in the treatment of diarrhoea and haemorrhage. Two centuries earlier, Marcin of Urzedowo (1595) described in more detail the curative properties of *P. erecta* rhizomes in the treatment of the above mentioned diseases, but also how the rhizomes can act as a healing and styptic remedy. Additionally, water extracts were used both orally and externally against leucorrhoea and infertility. It is interesting that the above descriptions have not followed those of Dioscorides, who recommended a condensed compression of the underground parts of *P. erecta* to bathe purulent facial eczema and to rinse oral cavity ulcerations (Tomczyk and Latté, 2009). Modern pharmacological studies show that interaction of the tannins with Rotavirus proteins could be a reason for the efficacy of *P. erecta* rhizome dry extracts in the treatment of childhood diarrhoea (Subbotina et al., 2003). Although rhizomes of *P. erecta* were traditionally used for curative purposes, current studies confirm that extracts of both aerial and underground parts can be used as remedies for inflammations, colitis ulcerosa, certain forms of cancer, viral and microbial infections, and diabetes mellitus (Geszprych et al., 2003; Tomczyk and Latté, 2009).

3.3. *Monographs of species native to Asia*

3.3.1. *Cinnamomum camphora (L.) J. Presl*

Family: Lauraceae Juss.

Common name: camphor

Latin and Polish name in Kluk's 'Dykcyonarz Roślinny' (Vol. II, item L.G. 503): *Laurus camphora* – Laur kamfora

The camphor tree is native to East and South Asia, where many linguistic groups cultivate it for gardening and ornamental use, for timber, as a pesticide and repellent, and for medicinal and cultural purposes. The roots and wood were traditionally used to treat fever, headache, rheumatism, traumatic injury and Keshan disease. The bark

and leaves are recommended for treatment of ulcers of the lower limbs and for skin pruritus, and the fruits for treatment of digestive disorders and gastroenteritis (Zhou and Yan, 2015). Camphor tree wood, twigs and bark are sources of camphor – a white, crystalline substance with a strong odour and pungent taste that has many pharmaceutical applications, including uses as a topical analgesic, antiseptic, antispasmodic, antipruritic, anti-inflammatory, anti-infective, rubefacient, contraceptive, mild expectorant, nasal decongestant and cough suppressant. Camphor is easily absorbed through the skin, and can also be administrated by injection, inhalation and ingestion (Chelliah, 2008; Hamidpour et al., 2013).

Kluk's monograph of the *C. camphora* tree contains a slightly inaccurate description of the origin of the species, although it could be a reason for the intensive introduction of the species to many countries. He included the description of camphor as a remedy against abscesses and skin diseases associated with inflammatory and pyretic symptoms, in both oral and external application forms. It is interesting that the earlier Polish herbalist Marcin of Urzedowo (1595) paid special attention to anti-aphrodisiac properties of camphor, described by Avicenna. He urged the compression of camphor, rose water and fennel in the treatment of ophthalmic disorders and also noted that overdose of this remedy can cause grey hair as a result of brain freeze. The comparison of the above two *C. camphora* descriptions demonstrates not only the progress of pharmacological knowledge over two centuries, but also Kluk's criticism of opinions of predecessors that had not been validated scientifically. According to the modern state of knowledge, *C. camphora* contains alkaloids and essential oils, such as camphor, and Type II ribosome-inactivating proteins (cinnamomin and camphorin) showing anti-inflammatory and anti-oxidative activity in vitro (He and Liu, 2003; Lee et al., 2006). Modern phytochemical studies also confirmed the effectiveness of eye drops containing *C. camphora* extracts in conjunctivitis, conjunctival xerosis, acute dacryocystitis, degenerative conditions and postoperative cataracts due to the anti-infective and anti-inflammatory properties of the herbs (Biswas et al., 2001). Jadhav et al. (2010) showed that camphor-treated rats showed a decrease in sperm motility and, thus, that camphor acts as a contraceptive; contrary results were reported by Shahabi et al. (2014). Therefore, opinions on camphor as a suppressor of sexual behaviour and sex hormones are still divided.

3.3.2. *Curcuma longa* L. and *Zingiber officinale* Roscoe

***Curcuma longa* L.**

Family: Zingiberaceae Martinov

Common name: turmeric

Latin and Polish name in Kluk's 'Dykcyonarz Roślinny' (Vol. I, item L.G. 6): *Curcuma longa* – Ostryż żółcień

***Zingiber officinale* Roscoe**

Family: Zingiberaceae Martinov

Common name: ginger

Latin and Polish name in Kluk's 'Dykcyonarz Roślinny' (Vol. I, item L.G. 2): *Amomum zingiber* – Amomek imbier

Curcuma longa and *Zingiber officinale* are medicinal plants belonging to the Zingiberaceae family and are currently cultivated in Asia. In traditional Ayurvedic/Chinese medicine, underground rhizomes of both species have been used as dietary spices and to treat different diseases since antiquity (Ramadan et al., 2011). The powdered rhizome of *Z. officinale*, rich in gingerols and shogaols, has long been used in traditional medicine for alleviating the symptoms of gastrointestinal illnesses (Trinidad et al., 2012). *Z. officinale* was not mentioned in the Hippocratic Collection but is attested to in Dioscorides' 'De Materia Medica'. The main therapeutic property and effect attributed to ginger rhizomes in Dioscorides' treatise is a warming and digestive action (Dioscorides, 2010; Touwaide and Appetiti, 2013). Marcin of Urzedowo (1595) reported the pharmacological activity of *zingiber* as dependent upon dosage form. Inhalations with *zingiber* were prescribed in the symptomatic treatment of epilepsy; the wine extracts of turmeric root, figs and raisins were prescribed for pulmonary diseases and of cumin for stomach disorders and flatulence; and fresh root with honey for gastroparesis. Kluk's taxonomy of this species is given according to the Linnaean system as *Amomum zingiber* L. (Vol. I, L.G. 2), while the name of the genus *Amomum* has Arabic origins (Mikaili et al., 2012). Kluk's description of medicinal effects of *Z. officinale* is brief and focussed on its neuropharmacological activity. Recent literature suggests that ginger shows considerable anti-inflammatory, antioxidant, anti-platelet, hypotensive, hypolipidemic, and hypoalgesic effects in in vitro, animal and pilot human trials (Nicoll and Henein, 2007; Lantz et al., 2007; Leach and Kumar, 2008; Lakhan et al., 2015).

Turmeric (*Curcuma longa* L.) rhizomes are known for their warm, bitter taste and golden colour related to their high curcuminoid content, and turmeric has commonly been used in fabric dyes and foods, such as curry powders. *C. longa* has been described as a treatment for inflammatory diseases and is referred to by different names in different cultures (Trinidad et al., 2012). *Curcuma* was included among medicinal plants of the Arabic world as hot and dry in the second degree, according to the work of Ibn al-Baytar, who compiled 9–13th-century Arabian medical literature (Touwaide and Appetiti, 2013). *C. longa* was probably described in Polish 16th century literature as *wodny ostrzyk Cyperus*, *Wilder Galgan* (Marcin of Urzedowo, 1595). The names *ostrzyż indyjski*, *curcuma*, *Cyperus indicus*, *Terra merita* and *Crocus indicus* were used by Syreński (1613). The authors mentioned its use as a diuretic for urinary stones, and choleretic and hepatoprotective actions, which is in agreement with ancient Eastern and Mediterranean medical traditions. Kluk affirmed precisely that he knew two species of the *Curcuma* genus and dedicated the monograph to one of them – *C. longa*. Kluk noted a purgative action of turmeric root, but he gave much more attention to the common usage of the root as a dye. Recent literature points out the anti-inflammatory and antinociceptive properties of curcumin and the effects of alleviation of symptoms of rheumatoid arthritis and inflammatory bowel disease (Tajik et al., 2008; Chandran and Goel, 2012; Asher and Spelman, 2013). Curcumin is poorly bioavailable, and its benefits are mediated via secondary metabolites (Gupta et al., 2013).

3.4. Monographs of species native to America

3.4.1. *Cinchona officinalis* L.

Family: Rubiaceae Juss.

Common name: Quinine

Latin and Polish name in Kluk's 'Dykcyonarz Roślinny' (Vol. I, item L.G. 228): *Cinchona officinalis* – Kina lekarska

The genus *Cinchona* L., quinine, is composed of 23 shrub or small tree species native to the mountains of southern Costa Rica and northern Panama and to the Andean mountains of Colombia, Venezuela, Ecuador, Peru and Bolivia (Andersson, 1998). It has not been possible to determine whether indigenous people started to use quinine to treat fevers, or whether the conquerors discovered the plant's effectiveness (Ferreira et al., 2012). In 1753, Linnaeus described the genus *Cinchona* and species *C. officinalis*, honouring the countess of Chinchón, wife of the viceroy of Peru, Luis Jeronimo de Cabrera, Fourth Count of Chinchón, with this name. The countess suffered strong episodes of fevers in Peru, which could only be treated with cinchona bark. Later, she travelled to Europe with powdered cinchona bark, thereby disclosing its efficacy for treatment of tertian fever. It was then that Europeans began to know about this product as the secret 'Chinchón powder', a story mentioned by Kluk and recently discussed with reference to historical data by Ferreira et al. (2012). Describing *C. officinalis*, Kluk underlined the unique medicinal properties of its bark – the most effective anti-inflammatory remedy and a tonic for weaknesses of all parts of the body. Because of its high price, physicians have looked for a substitute, but none of the native remedies (i.e., bark of ash (*Fraxinus* spp.), oak (*Quercus* spp.) or willow (*Salix* spp.)) was effective. The research on native substitutes of scarcely available exotic plants, performed by Kluk, proved his care for the social welfare of people of

those days. This conclusion could be linked to the above-mentioned opinion of Grębecka (2000) that 'Dykcyonarz roślinny' was a work elaborated for the common reader. The isolation of the antimalarial alkaloid quinine from the bark of *Cinchona* species (e.g., C. *officinalis*) was reported in 1820 by the French pharmacists Caventou and Pelletier (Gurib-Fakim, 2006). Other antimalarial alkaloids present in *Cinchona* bark include quinidine, cinchonine and cinchonidine. It should be emphasised that investigations on plant alkaloids, especially quinine, were the trigger points for the development of organic chemistry. Comparative analyses of the chemical composition of raw *Cinchona* materials imported into Europe were also the first practical applications of phytochemistry to plant taxonomy (Daszkiewicz, 2012). Kluk's valuable judgement of the unique curative properties of *Cinchona* and all above-mentioned species has been affirmed by subsequent results of scientific research with the use of more modern techniques up to the present day.

3.4.2. *Ipomoea purga (Wender.) Hayne*

Family: Convolvulaceae Juss.

Common name: jalap

Latin and Polish name in Kluk's 'Dykcyonarz Roślinny' (Vol. I, item L.G. 215): *Convolvulus jalappa* – Wilec salappa

Resin glycosides are constituents of complex resins unique to the Convolvulaceae family and are responsible for drastic purgative action. Several tuberous New World *Ipomoea* species, known under the name of 'jalap' (*I. purge*, *I. orizabensis* and *I. simulans*), comprise a group of highly esteemed purgative medicinals in American and European pharmacopoeias (Linajes et al., 1994). Their incorporation as therapeutic agents in Europe is an outstanding example of the assimilation of plant drugs from the New World as substitutes for traditional European remedies (Pereda-Miranda and Bah, 2003). Kluk's direct indication of the purgative action of *I. purge* rhizomes is a good example of the ready acceptance and popularisation in Europe as a succedaneum of scammony (*Convolvulus scammonia* L.). Kluk mentioned that jalap was commonly available in pharmacies but often confused with *Mirabilis jalapa* L. due to its similar names. This reflects the great demand for jalap in Europe and fast development of the production and export. Linajes et al. (1994) mentioned that between 1761 and 1851, the Xalapa-Xico area in Veracruz, Mexico exported 1.5 million tons of jalaps to Europe. Many of them were fakes of other Convolvulaceae. The proliferation of false jalaps between the mid-1500s and mid-1800s led to a great nomenclatural confusion, visible also in Linnaean taxonomy (McDonald, 1989) – a model for Kluk's 'Dykcyonarz roślinny'. Therefore, Kluk published *I. purge* under the genus *Convolvulus*, referring to Linnaeus' 'Systema Naturae'.

The phytochemistry of the *Ipomoea* genus has been studied since 1950. Some species of *Ipomoea* show antimicrobial, analgesic, spasmolytic, spasmogenic, hypotensive, psychotomimetic and anticancer activities (Meira et al., 2012). The purgative effect of *I. purga* is ascribed to resin glycosides; two nonlinear hetero-hexasaccharides of convolvulinolic and jalapinolic acids, purgic acids A and B, induce peristalsis in the small intestine, resulting in water elimination and numerous bowel movements within 1–2 h even after moderate dosages (Pereda-Miranda et al., 2010).

3.4.3. *Smilax spp. L.*

Family: Smilacaceae Vent.

Common name: Sarsaparilla

Latin and Polish name in Kluk's 'Dykcyonarz Roślinny' (Vol. III, item L.G. 1120): *Smilax salsaparilla* – Kolcowoy lekarski

The family Smilacaceae essentially consists of the single greenbrier genus (*Smilax* L.), composed of approximately 350 species of mostly tropical and subtropical distribution, which are still poorly understood taxonomically (Ferrufino-Acosta, 2010). The name sarsaparilla comes from the Spanish and means a small, brambling vine reflecting its habitat. *Smilax* rhizomes have been used in folk medicine in Central and South America. Among the indigenous peoples of the Amazon, *Smilax* rhizomes are used in treatment of leprosy and other skin diseases. *Smilax* has long been used by tribes for headaches, tumours, cancer, psoriasis and rheumatism and against the common cold. It is also reported to have testosterogenic, aphrodisiac and progesterogenic effects and is generally used as a tonic for physical weakness (Breitbach et al., 2013). Since the 16th century, *Smilax* has been exported widely from the Neotropics for use in the treatment of syphilis and rheumatism. Until now, it was not clear which species of *Smilax* contained the active components because of phenotypic plasticity of the species (Vermani and Garg, 2002; Ferrufino-Acosta, 2010). Also since the 16th century, *Smilax* has been used as a blood purifier and general tonic and has also been used worldwide for gout, syphilis, gonorrhoea, rheumatism, wounds, venereal diseases, arthritis, fever, cough, scrofula, hypertension, digestive disorders, psoriasis, skin diseases and cancer. Among the secondary metabolites of *Smilax*, steroidal saponins exhibit a range of bioactivities, including cytotoxic, haemolytic, anti-inflammatory, antifungal and anti-bacterial properties (Sparg et al., 2004). Kluk described the traditional use of *Smilax* in venereal disease treatment, but he underlined that there were many native species more effective as medicines against syphilis such as the bark of common juniper (*Juniperus communis* L.) and pedunculate oak (*Quercus robur* L.).

4. Conclusions

The substantive content and internal arrangement of Kluk's 'Dykcyonarz roślinny' reflect the ideal of systematisation of knowledge, advancement and progress typical of the Age of Enlightenment. This work incorporates high scientific quality, readability for its target audience, and wide practical knowledge. Monographs of 1586 species of algae, fungi and plants contain extensive botanical information, but their utilitarian value was also described in detail in a movement to provide education to a wider audience than the elite. Species descriptions were developed on the basis of Krzysztof Kluk's own scientific experience, supplemented by bibliographic references to ancient authors (Pliny the Elder, Dioscorides Pedanius), 16th and 17th century Polish botanists (Marcin of Urzędowo, S. Syreński) and Kluk's contemporary European authors. This demonstrates the receptiveness of the author to historical and contemporary knowledge and to the research methods of most eminent scholars of the age. Pharmacological activity assigned to particular species has found approval in large part in modern scientific research. Differences have been raised in terms of the forgotten uses of some herbs popular in the author's contemporary time. On the other hand, the omission of important current pharmacological applications of herbs resulted from the state of knowledge at that time being based on empirical experience. 'Dykcyonarz roślinny' by Krzysztof Kluk is a unique work of the Age of Enlightenment of great scientific, interdisciplinary and international value.

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