



Research article

Traditional application of Sage (*Salvia*) in conductive education and its potential evidence-based backgroundTímea Vissi^{a,b}, Romána Zekó^{c,*}, Renáta Földesi^a, Ibolya Túri^a^a *Semmelweis University, Pető András Faculty Institute for Conductive Education, 1125 Budapest, Kútvolgyi út 8, Hungary*^b *Doctoral School of Education, ELTE Eötvös Loránd University, 1075 Budapest, Kazinczy u. 23–27, Hungary*^c *University Pharmacy Department of Pharmacy Administration, Faculty of Pharmacy, 1092 Budapest, Hőgyes E. u. 7–9, Hungary*

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ABSTRACT

Conductive education originated in Hungary in the late 1940s as a unique form of education and rehabilitation for children with neurological motor disorder. The basic idea of András Pető's unique system (conductive pedagogical system) was that our nervous system, despite being damaged, has reserved the possibility of building new connections, which can be mobilised by the proper control of the learning-teaching process. Based on the accessible documents, the paper provides a comprehensive overview of the sageuse implemented by András Pető, the internationally acknowledged founder of conductive education. Besides the traditional application of sage in conductive education it also reviews the known phytotherapeutic effects and recent clinical trials. The available clinical trials confirm the successful traditional application of sage extracts in conductive education and provide a promising starting point for evidence-based studies regarding its application in conductive education.

1. Introduction

Medicinal plants have been gaining increasing interest worldwide as essential sources of bioactive compounds, and hence for their potential beneficial properties. The World Health Organization (WHO) reported that about 80% of the world's population use herbal medicine for the treatment of various diseases, referring to traditional drugs only as a second choice, due to a reluctance to use pharmaceuticals of chemical origin [1].

Sage (*Salvia officinalis* L.) is a multipurpose culinary herb that belongs to the family Lamiaceae/Labiatae. Common sage (*Salvia officinalis*) contains the highest amount of essential oil in its leaves among the different *Salvia* species on a dry weight basis. *Salvia* spp. leaves contain tannins, tannosetons, and essential oil. The identified components of the chemical composition of the essential oils in *S. officinalis* leaves was 97.97%, from which monoterpene hydrocarbons (C₁₀H₁₆O): 48.43%; oxygen-containing monoterpenes: 8.01%; monoterpene alcohols (C₁₀H₁₈O): 19.49%; sesquiterpene hydrocarbons (C₁₅H₂₄): 9.33%; sesquiterpene alcohols (C₁₅H₂₆O): 8.07% [2]. The oil of *Salvia officinalis* is rich in caryophyllene (23.2%), camphor (11.0%), and borneol (8.7%), while the oil of *Salvia lavendulae folia* is abundant in camphor, 1, 8-cineole, and 2-carene [3].

Sage species are rich in polyphenols (more than 160 polyphenol compounds have already been identified), including various phenolic acids and flavonoids. These phenolic compounds include caffeic acid and its derivatives, rosmarinic acid, salvianolic acids, sagecoumarin, lithospermic acids, sagernic acid, and yunnaneic acids. The most common flavonoids include luteolin, apigenin, hispidulin, kaempferol and quercetin [4]. In general, flavonoids are poorly absorbed after oral administration and are eventually metabolised in the gut and the liver. Furthermore, in an in vitro experiment in which the blood-brain barrier was modelled, it was found that some flavonoids and their glucuronide metabolites are likely to be able to cross the blood-brain barrier. Respectively, in vivo studies found flavonoid aglycones in rat brain tissue after oral administration of flavonoid glycosides.

Many essential oils are also found in sage species, with large amounts of terpenoids such as α and β -thujone, camphor, 1,8-cineole, α -humulene, β -caryophyllene, and viridiflorol. They also contain diterpenes and triterpenes, out of which carnosic acid, ursolic acid, carnosol and tanshinones are the most significant. Some studies suggest that the logP values of diterpenes in sage enable to cross the blood-brain barrier [5].

Depending on the species, the composition of the active substance varies [3, 6].

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The yield of essential oil from sage leaves is reported to vary from 1.1 to 2.8% on dry weight, and it depends on various environmental factors, such as average temperature, humidity, and rainfall [7]. The chemical compositions of *Salvia officinalis* essential oils obtained from plants grown in two locations of Ethiopia showed significant quantitative differences without qualitative divergence from most of the oils reported in plants growing in other parts of the world [8].

Conventional use has shown that sage leaves can be considered safe when used in recommended doses under the conditions of the European Pharmacopoeial monograph. The traditional medicinal use of sage leaves for at least 30 years (15 years in the European Union) has been found to meet the requirements for medicinal use under Directive 2004/24/EC for the following indications:

- Traditional herbal medicine to relieve mild dyspeptic complaints such as heartburn and bloating.
- Traditional herbal medicine to relieve excessive sweating,
- Traditional herbal medicine to relieve inflammation of the mouth or throat,
- Traditional herbal medicine to relieve minor dermatitis.

Due to the lack of safety data in children and adolescents, the use of sage leaves in children under 18 years of age is not recommended. However, due to the wide experience with the use, the limit values for the components of toxicological concern, and the lack of reports of serious adverse events, a sufficient safety level for use as a traditional herbal medicinal product can be assumed. Thus, sage leaf preparations can be considered as traditional herbal medicines.

Sage essential oil is characterized by high thujone levels. The consumption of sage essential oil in single-ingredient products is likely to result in exceeding the maximum recommended daily intake of thujone [6]. Thujone is toxic and can cause seizures in high doses. The available clinical and toxicological data on sage essential oil do not meet the criteria for developing the European Union herbal monograph [9].

Sage contains sesquiterpenes, which have a relaxing and balancing effect, which well complements the psychiatric effect of aroma massage [10].

Dr. András Pető created the conductive education system (CES) for people with damaged central nervous system 70 years ago. CES is a complex, pedagogical, habilitation-rehabilitation system in which he combined his medical knowledge and sanatorium experiences with pedagogical, special educational elements. Pető used an increasing-temperature bath with sage and a warm sage wrap to relax the spastic muscle tone. Nowadays, professionals of CES, the conductors, do not use the increasing-temperature bath and the warm wrap, but the sage herb — in cream form — is used still to relax the spastic muscle tone. The sage cream (Bioextra *Salvia officinalis* massage cream, Bioextra Co. Ltd.) contains 4% standardized *Salvia officinalis* extract (CAS: 84082-79-1) and 0.02% *Salvia officinalis* oil (CAS: 8022-56-8). The scientific and clinical study of the effect of sage cream has not been yet performed.

The present study was written with a dual purpose: as a preliminary study of a clinical trial, and as an opening article of the Issue in memoriam András Pető. The clinical trial is organized by Semmelweis University's András Pető Faculty (SUAPF) and Faculty of Pharmaceutical Sciences (SUFPhSc) to assess the effects of the current sage use with a massage cream available on the market as a cosmetic preparation. In order to match the knowledge of professionals from different backgrounds and research position, it was necessary to summarize the current knowledge in the literature about the sage herb and the application of sage in CE. This article also presents the different knowledge and research positions of the experts of the two — pharmaceutical and education — sciences, which rarely cooperate with each other in joint research.

The András Pető memorial issue was created to provide 21st century responses to the changing social, disability policy, educational and health challenges of the 21st century. We invite conductive education centers in

different countries around the world and related practitioners and researchers to engage in dialogue. A common language is needed for a common dialogue, so this special issue is also in line with this international expectation.

We would like to pay tribute to the memory of András Pető with this article, who combined his experiences and the elements of various sciences in the system he created. This study also combines different disciplines, pharmacological knowledge with scientific examination of experimental knowledge. Our goal is to systematize and summarize the hard-to-reach, mostly Hungarian documents and articles in the resource center of the SUAPF, and the literature about the effects of sage known as an herb.

2. Method of retrospective research

We used the document analysis and questionnaire interview methods to summarize experiential knowledge. We studied contemporaneous documents of the Pető legacy from the Mária Hári Library and Source Centre of SUAPF, publications by András Pető and by his close colleague and subsequent head of the institution Mária Hári, reminiscences on Pető, archival documentation of the institution, and gathered information from research on Pető's life and on the history of the institution.

To detect sources, we used the electronic database of the András Pető Library (Kondpedita), first applying the terms "sage" and "sageuse", then, as the research progressed, employing theory-based sampling of GT, the terms "bath", "hot wrap", "heat" as search terms. First, we checked the list of 156 hits according to titles and omitted those where sage was not mentioned as part of or in relation to the conductive education system. Then, we read the remaining 135 hits and arranged them in three categories according to content:

- appears in the tasks of a particular patient or group,
- included in or related to a theory description,
- its position and role in conductive education.

To explore what information Pető could have had, we went through his inheritance, electronically stored, and systematized in Kondpedita in the library of SUAPF. A substantial part of Pető's books is written in German; thus, the search was extended to the terms "Salbei" and "Warmbad". The 97 hits were processed in the same way as those gained with the help of the search terms in Hungarian. The 227 hits — in Hungarian and in German — were then arranged in chronological order.

The data on the number of the institution's clients, their diagnosis, and the rehabilitation procedures were gathered from the documentation stored in the archives of the SUAPF, which has only been partially discovered scientifically.

3. Traditional application of "sage use" in conductive education

It is needed to describe the terminology and the related concepts before describing the results. The name of Pető's system and the title of the professionals working in this system have changed several times. Today's terminology was used in the study, so the system of complex procedures developed by Pető is called "conductive education system" (CES), and the professional is referred to as "conductor". The names of the diagnoses have also changed in the past 70 years, so today's terminology is used here as well. The institution founded and managed by Pető became famous in Hungary and internationally as the "Pető Institute"; it is referred as an "institution". In the archived and the contemporary documentation of the clients, the procedure is referred to as "sageing", which is a term created by conductors and used only at CES. It is important to emphasize that "sageing" is a triphase procedure (the numbering also meaning the sequence): 1. use of the sage plant in some form (bath, wrap, cream), 2. passive joint exercise, 3. active task accomplishment. The term "sageing" is used in this threefold meaning in the present article.

The other terms used in the article specifically related to CES, 'jargon' are explained in the relevant parts of the text.

By reviewing Petó's work, the initial documentation of the institution, and the research on Petó's life, it can be established that Petó adopted the increasing-temperature bath and warm wrap combined with massage, followed by active exercising to reduce the contracture. This procedure was based on his sanatorium experience and the scientific knowledge of that time [11, 12]. The effect of the increasing-temperature bath and warm wrap was enhanced using sage herb from beginning [13, 14, 15, 16, 17, 18, 19, 20, 21, 22].

The practice of increasing-temperature baths is described in Petó's book (written in German and published under a pseudonym [23]), as well as by Hári [24]: "The patient is seated in a bath of 36–37 °C, and then hot water is added, increasing its temperature to 42 °C within 30 min. After the bath, the patient is wrapped in a flannel blanket and covered in six woolen blankets." [23].

However, the contemporary literature does not mention procedures for reducing the spastic tone that does not yet cause contracture. Accordingly, neither in Petó's writings nor in the documents of the institute was there any mention of reducing the spastic musculature in the initial period. It first appears in 1957, and Petó emphasised that "there is no need for physiotherapy or medication for reducing spastic tone if the rhythmic intention is appropriate" [25]. Rhythmic intention is a special method within the conductive education system: clients accompany movement with speech in first-person singular to raise intention and awareness, thus providing rhythm and sufficient time to accomplish the task.

Summarized, Petó applied "sageing" primarily for reducing contractures.

The data of the clients were examined in the archived documents of the institute in order to reveal the practice of "sageing" in different decades and the reasons behind the changes made to "sageing".

The muscle tone of the clients was not documented in the institutional documentation until the '80s, so the number or the rate of the clients with spastic muscle tone is not known, but it can be deduced from the diagnosis. The rate of spasticity in cerebral palsy (CP) is 85–90% [26, 27], and the rate of CP in the diagnosis of admitted clients is sharply increased. The improvements made in the practice of sageing and the diagnosis of the clients in the institute are shown in Table 1.

At the beginning, in the 1950s, only 30% of the clients had cerebral palsy [28], this proportion increased to 60% in the 1960s [29] and, based on a study [30], it was already 91.4% in 1968. Reducing of spastic muscle tone came to the fore and the conductors resorted to the well-established sageing for dissolving contracture. The practice of sageing was changed: it appeared in the groups' daily routine several times a week as a separate program. "Sageing" continued to mean the increasing temperature bath and warm wrap.

From the 1980s until the 2000s, the 90–92% CP rate remained. "Sageing" was applied to all children with spastic muscle tone, 4–5x a week, before active task-solving. The goal was to achieve reduced muscle tone, as close to normal tone as possible, and start the active functioning of the muscles from this relaxed initial condition. The 'increasing temperature bath' mark has gradually disappeared from the documentation; it was replaced by the warm sage bath. The sage cream appeared in 1997, which was easier and faster to use. The other change is that in the adult department, due to the reduction in the number of hours per day, "sageing" has ceased.

The institution's kindergarten opened in 2000, and so did its school in 2004, beginning the co-education of children with and without disability, so the proportion of clients with CP declined slightly. "Sageing" in children with spastic muscle tone continued according to the practice of the 1980s, but the baths and wrapping was increasingly replaced by applying a cream.

Nowadays, only the sage cream is being used, and "sageing" is a separate program before the other program, but only 1–3 times a week. Due to the increased school hours, "sageing" is missing in the adolescent groups.

Table 1. The development of the practice of sageing at the Institute from 1950 to the present day.

Year	Rate of CP in the diagnosis of clients	The practice of reducing muscle tone		
		Typical way of reducing muscle tone	Practice of "sageing"	Frequency of sageing
1950	30%	rhythmical intention	increasing temperature bath, wrap (only for reducing contracture)	in 1–2 cases, individual task
1960	60%	rhythmical intention	increasing temperature bath, wrap (only for reducing contracture)	in 1–2 cases, individual task
1968	91.4%	rhythmical intention, sageing	increasing temperature bath, wrap	it appears in the groups' program; fix spot in the daily routine
1980s	90–92%	rhythmical intention, sageing	bath, wrap	fixed spot in all groups' daily routine; every child with spastic muscle tone starts the day with sageing every day of the week
2000s	80–85%	rhythmical intention, sageing	bath, wrap, sage cream	fixed spot in all groups' daily routine; every child with spastic muscle tone starts the day with sageing every day of the week
2020s	70–75%	rhythmical intention, sageing	sage cream	fixed spot in all groups' daily routine; every child with spastic muscle tone under 10–11 years old starts the day with sageing 1–3x a week

4. Pharmacological effect of sage extracts

Due to the rich array of chemical composition (phenolic acids, flavonoids, terpenoids, polysaccharides), plants of genus *Salvia* possess various pharmacological activities, including anticholinesterase, neuroprotective, anticancer, antiviral, anti-inflammatory, and antioxidant [31].

Monoterpenoids, including 1,8-cineole and α -pinene, are used traditionally in European medicine for memory disorders; its use is first mentioned in 16th and 17th century English herbals [32]. Various CNS effects have been reported for different *Salvia* species, including memory enhancing, neuroprotective, and antiparkinsonian activities [33].

Extracts and oils from *S. officinalis* and *S. lavandulifolia* are antioxidant, antiinflammatory, and inhibit acetylcholinesterase; the latter activity is associated with oil monoterpenoids (1,8-cineole and α -pinene) [34, 35].

A standardized oil extract of *S. lavandulifolia* produced significant effects on cognitive ability (immediate word recall scores improved) in healthy young adults (RCT) [36]. A similar study showed positive modulation of mood and cognition in healthy young adults given standardized essential oil of *S. lavandulifolia* [37]. *S. officinalis* extract enhanced secondary memory performance in adults (>65 yr age, RCT) [38].

In a pilot trial (11 patients with mild to Alzheimer's disease) *S. lavandulifolia* oil significantly improved cognitive function, reduced neuropsychiatric symptoms, and improved attention [39]. In a multi-

centre randomised clinical trial, Alzheimer's disease patients treated with *S. officinalis* extract had significantly better results in cognitive function tests [40].

Although various Sage species were recommended for the treatment of a 'weak brain' in the 17th century, most pharmacological research on sage has been done with the essential oils of *Salvia officinalis* and *Salvia lavandulifolia* in the recent decades. These remedies helped those who shiver and suffer from the effects of stroke and strengthen weak minds and improve memories. The latter resulted in various promising pharmacological results, which have been published. Perry et al. [34, 39, 41, 42] provided studies, summarizing available literature on the use of *Salvia* species in dementia therapy. Savelev et al. [35] examined the inhibition of the butyryl- cholinesterase by essential oils from *Salvia fruticosa*, *Salvia officinalis* var. *purpurea*, *Salvia officinalis* and *Salvia lavandulaefolia*. The IC50 values measured after 5 min of incubation were 0.05, 0.4, 0.03, 0.07 and 0.03 mg/ml, respectively. Additionally, pure compounds from the oil were tested, none of which could fully account for the activity of the essential oils. *Salvia lavandulaefolia* and *Salvia officinalis* *purpurea* oils had apparent dual cholinergic activity, as they were active on both, acetylcholinesterase and butyryl- cholinesterase [43]. Besides the cholinergic activity, there has already been a wider range of activities reported for the genus *Salvia*, which may be relevant for CNS disorders. In a double blind, randomized, placebo-controlled trial with 39 patients, Akhondzadeh et al. [40] assessed the efficacy and safety of *Salvia officinalis* extract in patients with mild to moderate Alzheimer's disease. The participants experienced statistically significant benefits in their cognitive abilities after 16 weeks of treatment. Despite the limitations of this study, a small number of patients and a relatively short period of follow- up, this initial clinical data suggest that *Salvia lavandulaefolia* essential oil and extracts may have potential for treatment of Alzheimer's disease and memory- related disorders.

Sage might help with chemical imbalances in the brain that cause various CNS symptoms [36, 37, 42, 44, 45, 46]. The results of a recent study support the use of *Salvia* off., and more specifically, the thujone-free proprietary extract, for the specific treatment of a wide range of somato-vegetative and psychological symptoms experienced by menopausal women, and correlate this effect to a restoration of associated dysbalanced brain waves [47].

5. Concluding remarks

Based on the available resources, CES applied increasing- temperature sage bath and warm sage wrap to relieve non- fixed contracture from the beginning. As the rate of clients with CP increased in the institute, the possibility of reducing spastic tone also came into focus...„Sageing” became an everyday practice among the clients with spastic musculature, in order for them to reach a relaxed condition before active task-performing, and start the effective learning process from this initial condition.

The currently applied sage cream appeared in 1997 and gradually replaced the sage herb administered as bath and wrap; finally, in 2010, the Institute's groups switched to the sage cream's exclusive use. No scientific or clinical studies have been performed on the effects of sage cream. The present paper is a preliminary study of the planned survey on sage use.

The described biological and clinical trials confirm the successful traditional application of sage extracts in conductive education and provide a potentially promising alternative for new therapeutic applications.

Declarations

Author contribution statement

Tímea Vissi ; Romána Zelkó ; Renáta Földesi ; Ibolya Túri .: Analyzed and interpreted the data; Wrote the paper.

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The authors declare no conflict of interest.

Additional information

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