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KOKEDAMA – THE JAPANESE TECHIQUE OF PLANT CULTIVATION AND ITS POTENTIAL FOR THERAPEUTIC APPLICATIONS

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ABSTRACT

Kokedama is a Japanese art of growing plants using natural substrates, moss and ornamental plants, which is in line with trends of the bonsai art. It is a soilless and containerless cultivation method that allows reducing amounts of plastics and aids the care for the natural environment. It has also been proven that not only growing plants, but also just staying in their vicinity has a positive effect on human mental and physical health. These positive effects have been observed in ancient times when plants were introduced into the living space. Today, this is particularly important in the era of urbanization and spending more time indoors, which increases man's pursuit of contact with the natural environment. This work attempts to present the possibilities of using kokedama in horticultural therapy aimed at improving socialization of the populations.

Keywords: soilless cultivation, ornamental plants, containerless cultivation, human health

INTRODUCTION

In the modern world, more and more attention is paid to the aestheticization of the living environment of man. It pertains not only to residential premises and directly adjacent green spaces, but also to public buildings such as offices, hospitals, kindergartens or schools. Plants are one of the largest groups of living organisms accompanying humans and modeling their space, with plant-human relations dating back to the beginnings of the human evolution [Schaal 2019]. This is particularly noticeable in the Greek and Roman civilizations, where ornamental plants (*Hyacinthus* L., *Narcissus* L., *Hedera* L.) were used due to their reference to mythology [Francini et al. 2022]. The continuous need for closeness with nature in the man's environment does not change in the environment of a modern city [Kellert and Wilson. 1993] especially given the 68% increase expected in the urban population worldwide by 2050 [United Nations, 2025]. Many people cannot imagine life without plants in their environment [Gronostajska 2007, Selim 2021, Yerli and Sitemoglu 2024]. The beginnings of growing plants in closed spaces were recorded several thousand years ago in China [Zimny 2008]. In Egypt, plants were brought to houses in the 3rd century BC, and it is known from the ruins of Pompeii that indoor plants were already known more than 2,000 years ago

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[Bringslimark et al. 2009]. According to Deng and Deng [2018], city dwellers spend about 80–90% of their lives indoors, which is forced by the contemporary lifestyle. Therefore, increasing emphasis is being put on growing plants inside buildings. At home, plants contribute not only to environment purification or space aesthetics but also elicit beneficial effects on human health [Bermejo and Sparke 2019]. In the context of the COVID-19 pandemic, a significant improvement has been noted in the mental health of persons having contact with plants [Tu et al. 2020, Phillips and Schulz 2021, Pérez-Urrestarazu et al. 2021]. And this effect was even enhanced by the activities linked to the care, planting, watering or fertilizing plants and making plant compositions [Han 2018]. Such activities are part of a horticultural therapy, i.e., a form of treatment based on the natural relationship between humans and nature [Górska-Kłęk et al. 2009].

Given the above, programs aimed at improving human mental health are developed that integrate elements of the natural environment, such as landscape, natural light, plant scents, natural materials, the sound of water and birdsong with people's everyday lives [Mcsweeney et al. 2015, Chung et al. 2024]. Small areas or unfavorable habitat conditions are no longer bottlenecks to the cultivation of various plant species, and even persons who do not have large spaces can benefit from such a therapy. Modern technologies for controlling artificial light, self-irrigating containers as well as soilless cultivation methods including hydroponics, aeroponics or aquaponics are viable and helpful solutions in this case. Hanging compositions are popular as well, e.g., green vertical walls which impart a modern style to rooms [Azkorra et al. 2015, Venuh et al. 2023]. Minimalism, simplicity and elegance are highly valued. That is why, soilless and containerless cultivation becomes more and more common as it offers a great visual effect and simplicity, thereby bridging the indoor space and the natural environment of people's life [Mackoś-Iwaszko and Nowak 2017]. An example of the modern introduction of green vegetation to rooms is kokedama, namely, the Japanese art of plant cultivation harnessed also for the purposes of horticultural therapy. Growing plants in a substrate mixture wrapped in moss ("moss ball"), either suspended or standing, not only results in producing a decorative element, but also could be an example of horticultural therapy [Han 2018, Chung et al. 2024].

The aim of this work is to present the characteristics and possibilities of Japanese plant cultivation, such as kokedama, so that it can be successfully used in horticultural therapy, emphasizing its ease of creation and subsequent maintenance.

THE IMPACT OF ORNAMENTAL PLANTS ON HUMAN HEALTH AND WELL-BEING

In the contemporary world, where people are exposed to excessive stimuli, they need peace and quiet, which can be provided by their contact with nature. Ehrlich and Raven [1964] are creators of the "coevolution" concept, which refers to the process in which species interact with each other. Its definition also encompasses the relationship between plants and humans, including the beneficial ones. The biophilia hypothesis assumes that humans possess an innate need to seek connections with nature [Kellert and Wilson 1993].

The beneficial effect of potted plants on human general health, mental health and well-being has been proven in scientific research. Staying among potted plants is associated with mitigated feeling of pain, fear, unhappiness and aggression [Burchett et al. 2008]. In their survey conducted among 1,200 German consumers, Bermejo and Sparke [2019] showed that having ornamental plants at home not only resulted in satisfaction with the appearance of the living space but also generally improved the quality of life. Interiors with green plant elements allow for contact with nature, thereby satisfying people's longing for a natural environment and alleviating the feeling of stress compared to the interiors without plants [Thomsen et al. 2011, Deng and Deng 2018]. Studies conducted in the United States, Europe, Asia, and the Middle East confirm the positive impact of horticultural therapy on human health, in terms of reducing depression and anxiety, as well as increasing life satisfaction and quality [Soga et al. 2016, Zawiślak 2024]

Other authors [Grinde et al. 2009] also emphasized that potted plants can help reduce stress and suppress negative emotions. Improved well-being and even improved cognitive functions under the influence of contact with potted plants were demonstrated by Han et al. [2022]). Another experiment investigated the interac-

tion between plants and humans. To this end, 24 men were divided into 2 groups, and those from the first group were asked to replant a *Peperomia dahlstedtii* C.DC. plant, while those from the second group were given a task involving computer work. Men's feelings during replanting activities were different compared to those of men performing the computer task. Contact with plants provided a sense of calmness and comfort, as evidenced by the sympathetic nervous system examination and blood pressure measurement [Lee et al. 2015]. An empirical study conducted in China, which examined 430 participants, found correlations between plant care activities and psychological well-being [Ma 2022]. Persons in contact with nature had a low brain wave frequency and lesser brain activity in the frontal areas, which indicates regeneration and a sense of relaxation and relief [Norwood et al. 2019]. In addition, contact with nature can help suppress negative emotions resulting from stressful life events [Van den Berg et al. 2010].

Having plants in the man's environment is important not only in residential premises but also in offices or public utility buildings. An office with plants can have a positive effect on employees [Elzeyadi 2011], including their work comfort, mood, creativity, and stress reduction. This is partly due to increased humidity and the absorption of harmful substances by plants. Owing to their phytoremediating ability, green plants act like filters and are potent to absorb total volatile organic compounds (TVOC), carbon monoxide (CO), CO_2, formaldehyde and benzene [Hall and Knuth 2019, Liu 2022]. Having plants in the office is a viable means to increase overall productivity without too much extra spending [Husti et al. 2015]. Nieuwenhuis et al. [2014] proved that workers who had plants in their view completed a concentration test 19% faster compared to those who were not surrounded by plants. The Rural Development Administration of South Korea recommends placing one small potted plant and one large potted plant per 6 m^2 of floor space to improve the interior's quality [Kim et al. 2013]. Three small-sized or medium-sized plants in the interior have been shown to exert a positive effect on the mood, productivity, and reaction time of workers [Jumeno and Matsumoto 2013].

Contact with plants has also a positive effect on children's well-being, concentration, and reduces aggressive behaviors between peers [Nowak 2005]. ADHD children concentrate better after a walk in the park [Taylor and Kuo 2009]. In schools having green walls in classrooms, children received better scores in concentration tests and achieved 20–26% better academic results, learning the curriculum faster [Van Duijin et al. 2011, Van den Berg et al. 2017]. At universities, contact with plants and their care by students were reported to contribute to relieving stress, tension and anxiety, and also eliminate sleep problems [Yang et al. 2024]. Horticultural therapy is most commonly used among people with mental disabilities, after strokes, with sensory disorders, hearing and vision impairments, in depression, paralyzed individuals, as well as those excluded from society, alcoholics, drug

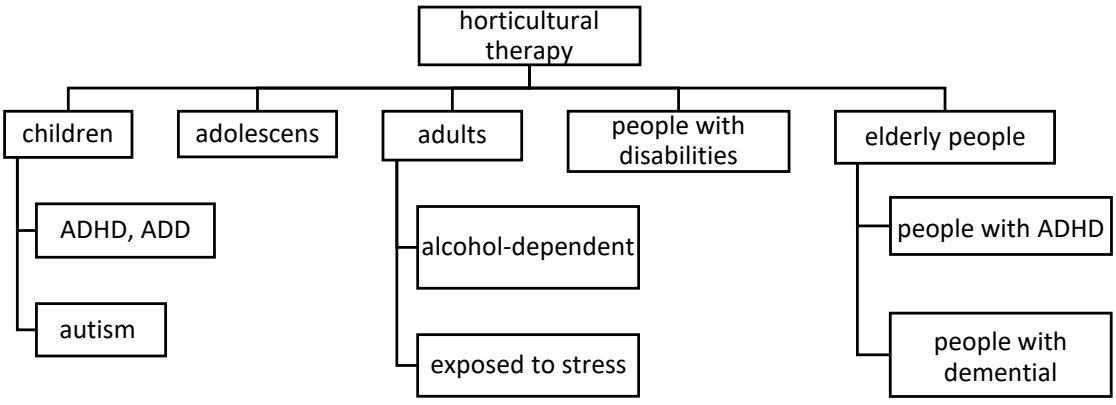

Fig. 1. Horticultural therapy as an element supporting the therapy of various groups of people

addicts, or people in prison (Fig. 1) [Zawiślak 2015, Mackoś-Iwaszko and Nowak 2017].

KOKEDAMA CONCEPT

Kokedama is an art of plant cultivation originating from Japan. Like bonsai, it is created using ornamental plants in minimalist arrangements. The exact origins of kokedama are inexplicit, but it probably began in Japan's Edo era (1608–1868), based on the Nearai Bonsai method, and was propagated by persons from lower social classes as a substitute for bonsai. Therefore, some authors call it "bonsai for the poor" because the plants do not require specialist pruning nor appropriate containers [Oshima and Kimura 2017, Lokare and Keshamma 2021]. It is believed that kokedama fits into the Kawai style that has been prevailing in Japan for 40 years [Esentürk and Yerli 2019] and pertains to a container-free and soil-free cultivation of plants. The roots of the plant are covered with a special substrate mixture, which is formed in the shape of a ball. In order to maintain optimal conditions for the root system development and thus for plant growth, the ball is coated with a layer of moss and wrapped with a string. Therefore, the term kokedama comes from the Japanese words "koke" meaning a ball, and "dama" meaning moss. Kokedama is used to grow many species of plants, including herbs, grasses and ferns, but most often it serves to grow ornamental plants [Sunamori 2012, Ibrahim 2025]. Kokedama can be in a hanging or a standing form. A properly composed substrate provides stable air-water conditions and prevents moisture loss. The moss ball is watered once a week or less frequently by immersing it in water when the substrate had dried out [Putra et al. 2021]. As the authors report, kokedama is an ecological and social plant cultivation method since it uses organic substrates and natural materials, and there is a complete elimination of plastics [Wiyatasari 2019, Panglipurningrum et al. 2024, Afnan et al. 2025].

Kokedama substrates

Kokedama is a cultivation system where a specially composed mixture of substrate with added water is stuck to the roots of plants and wrapped with moss [Oshima and Kimura 2017, Mitarai 2021]. The mixture consists of keto, akadama, and zeolite. Keto is a Japanese substrate used for growing bonsai. It is

a) b)

Fig. 2. Orchids (a) – *Phalaenopsis* Blume, and crocus (b) – *Crocus* L. in kokedama cultivation. Photo by K. Pitura

a mixture of peat and soil from swampy areas of Japan. It has very good sorption properties, retains moisture and nutrients well, and has a dark brown color [Pietraszko and Sobota 2008].

Akadama is a slightly acidic volcanic soil, commonly found in Japan and called mud. It has a wide range of applications as an additive to the substrate due to its osmotic properties for oxygen and water [Budinova et al. 2009].

Zeolite is a naturally occurring, alkaline, hydrated aluminosilicate with a broad range of applications. It is of great importance in horticulture. Natural zeolites improve soil quality as they exhibit good water and nutrient retention capacity. They also possess chelating capacity, improving the sorption properties of soils [Elliot and Zhang 2005, Mondal et al. 2021].

HORTITHERAPEUTIC PROPERTIES OF KOKEDAMA

Horticultural therapy is a form of therapy related to the mental and physical regeneration of a person based on the genuine relationship between man and nature. This kind of therapy can be passive, aimed at observing nature and deriving health benefits from it, or it may take an active form including gardening work [Zawiślak 2015].

Kokedama fits into both passive and active parts of horticultural therapy. The passive aspect appreciates the aesthetic dimension and the green color, which has a calming effect on people. According to Eliot and Maier [2014] and Liu [2022], the color green has a soothing and relaxing effect, and makes people focus more on their inner experiences. The manual activity of mixing the substrate and shaping the ball could potentially support motor coordination and may enhance sensory stimulation. Caring for a finished kokedama, such as watering, fertilizing, or replenishing the moss, might constitute an element of active horticultural therapy, as well.

Plant-related activities complement conventional rehabilitation methods. They can be implemented in every age group, among patients with physical, mental and psychological disorders. Horticultural therapy helps in social integration and addiction therapy [Catlin 1998, Górska-Kłęk et al. 2009, Reis et al. 2020]. Kokedama is easy to grow; hence, it can become a substitute for a garden or a minimalist green form in the man's environment, which will contribute to health improvement in times of the growing ecological crisis [Pyurko et al. 2024].

Research conducted in the city of Batu allowed concluding that kokedama has a high aesthetic value,

a) b)

Fig. 3. Keto (a), and akadama (b) substrates. Photo by K. Pitura

attracts the attention of recipients, and ensuring pleasure in perceiving green vegetation. The care over plants is not troublesome as they require watering twice a week. Therefore, this form of cultivation is easy and convenient even for persons inexperienced in gardening [Putri and Siswadi 2024]. Yerli and Sitemoglu [2024] proves that kokedama has a positive effect on both the persons and the space they function in. In interior design, it enlivens the space, eliminates monotony, ensures a balance of colors and textures, and affects the aesthetics of the entire room, which facilitates man's functioning in this space. The appearance of kokedama has also an artistic dimension and therefore this type of plant cultivation is often called the "art of kokedama".

Kokedama was promoted in Indonesia as a social activity. During the COVID-19 pandemic, an online program was developed with training materials that precisely showed the planting method using this cultivation technique so that entire families locked in their homes could create unique decorations from plants and then take care over them [Sinaga et al. 2020]. Kokedama cultivation can be implemented as a method of therapeutic socialization. The Family Welfare Movement introduced kokedama-making workshops for mothers in Malaysia. In small villages, 30 women were taught to grow plants using this technique. The aim was to unite these women, and teach them how to grow plants appropriate to the environment and opportunities in which they live [Wiyatasari and Hum 2019]. The kokedama concept is environmentally friendly because it eliminates the use of plastic pots. Training in this technique was carried out among a group of Indonesian women and strengthened their social position and helped them understand the idea of recycling [Pintakami et al. 2024].

The psychological aspect of kokedama was investigated by Mitarai [2021]. A group of elderly and unemployed persons reported to experience peace and joy just by looking at kokedama installations. In turn, training in kokedama-making was conducted in the village of Tabang Kacang (Indonesia), to empower the position of village's housewives [Zulfita and Budi 2024]. In Sidomulyo (Indonesia), i.e., a village famous for growing ornamental plants and frequently visited by tourists, kokedama cultivation was introduced to increase their sales and help local residents make a living from tourism [Batu et al. 2021].

The research by Tu et al. [2020] noted the impact of kokedama on human health. A group of 27 people aged between 60 and 75 years underwent studies on the effects of horticultural activities as two plant cultivation methods Grass Doll and Kokedama, artistic creation Rocky Leaf Prints, and activity combined

a) b)

Fig. 4. Zeolit substrates (a), materials needed for kokedama preparation (b). Photo by K. Pitura

a) b)

Fig. 5. Marantha's (*Maranta leuconeura* Kerchoveana) in kokedama. Photo by K. Pitura

tasting and smelling of herbs. Based on the results of the study, engaging in a kokedama activity significantly reduced salivary amylase activity (SAA) among elderly participants, indicating a marked reduction in acute stress response. Moreover, kokedama contributed to a downward trend in pulse rate and in the ratio of low-frequency to high-frequency heart-rate variability (LF/HF), suggesting a shift toward increased parasympathetic (i.e., relaxation) nervous system activity. Participants also reported a significant decrease in "anger" (a negative mood subscale) and a significant increase in "vigor" (a positive mood subscale) after kokedama, demonstrating improved emotional well-being [Tu et al. 2020]. Moreover, kokedama increases creativity, and self-satisfaction that encourages students to take responsibility for caring for the plants, nature and environement [Afnan et al. 2025]. Kolański and Warachim [2023], conducting horticultural therapy among individuals with brain injury accompanied by cognitive dysfunctions and motor impairments. Authors observed an increase in muscle strength of the patients, improvement in their physical endurance, and an increase in the range of joint mobility. The horticultural therapeutic significance of kokedama can be emphasized during the preparation of the substrate. Mixing the blend with water helps increase the mobility of the wrist joints and allows the senses to perceive different textures.

In Poland, kokedama is less known plant cultivation method. Kokedama could be made with various plants e.g. *Chlorophytum* Ker Gaw, *Hedera helix* L., *Chamaedorea* Willd, *Epipremnum* Schott. (Fig. 5). The authors of this article conducted numerous kokedama-making workshops in various social welfare centers (Figs 6–7) during which they observed specific effects of this activity on participants. Residents consistently demonstrated noticeable satisfaction and engagement when provided the opportunity to interact directly with plants. In addition, persons with intellectual disabilities within the ADHD spectrum appeared to experience enhanced calmness, likely facilitated by the sensory stimulation associated with substrate mixing together in the group, and the manual formation of moss balls.

CONCLUDING REMARKS AND FUTURE PERSPECTIVES

Although kokedama represents a relatively old art of plant cultivation, its therapeutic properties remain insufficiently elucidated. Existing scientific publications acknowledge its horticultural relevance, with the majority of studies and practical implementations

Fig. 6. Crokus (*Crocus* L) kokedama making workshops in Warsaw (Poland). Photo by K. Pitura

a) b)

Fig. 7. Kokedama making workshops in school in Poland with disabled persons (a and b). Photo by K. Pitura

reported in Indonesia. In contrast, no documented applications of kokedama as a therapeutic method have been identified in Europe or the Americas, where it has predominantly been described in decorative or amateur contexts. Until now, it has been considered only as a decorative element, but increasing body of literature suggests its potential applicability within horticultural therapy. However, its potential therapeutic benefits require further systematic and comprehensive research. Due to its simplicity of preparation, and the availability of required materials, kokedama may hold substantial promise as an accessible horticultural therapy tool across diverse age groups. Its ecological character, relying exclusively on natural materials, further enhances its suitability for contemporary therapeutic and educational practices.

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